Notes of

Lectures

upon

Chemistry

By

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taken by

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Mr: Rouelle of Paris defines Chemy: thus.

" La Chymie est un Art physique qui
" par le moyen de certaines Operations et
" de certains Instruments, nous enseigne
" a seperer les Corps plusieurs Substances
" qui entrent dans leur Composition, et a
" les recombiner de nouveau entr'elles
" ou avec d'autres pour reproduire les
" primier Corps ou pour en former de
nouveau. L'utilité des Arts, & les besoins
" de la vie sont le but qu'elle se propose.

Chemistry instead of being ye most ancient, is really ye most modern of all Sciences. even to this day wth most of People the Idea of Chemistry is limited, imperfect and inaccurate. they do not agree concerning ye nature of the Art. therefore since our Notions of Chemistry are not ye most common, we think it necessary to begin by giving the Ideas wch Chemists themselves have had of their Profession.

Towards ye End of ye 16th Century, soon after Paracelsus, Sennertus gives

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the following Definition of it in his "Dissertatio de Consensu & Dissensu inter Galenicos et Chemicos" "It is (says he) the Art of resolving minerals for ye purposes of Pharmacy & Alchemy. This Notion of Chemistry is so visibly imperfect that we shall not insist upon ye Faults of it, but proceed to Bequinus who says "it is ye Art of resolving and compounding minerals for ye purposes of Pharmacy & Alchemy" - he instructs you see a little upon his Predecessor by adding ye word compounding, but ye Insufficiency of this Opinion is so apparent, yt we shall pass on to

Homberg's who says " Chemistry is ye Art of resolving and compounding Mi=
=nerals by means of Fire. this is an
Improvt: upon ye two former, but he
has put a heavy Clog upon it when he
says, by means of Fire " —

Macquair's Definition abounds wth
Terms as difficult to be understood as ye
word Chemistry itself. in Short all who
have attempted to define Chemistry have
erred by considering it as an Art, and not
as a Science.

Dr. Shaw has endeavoured to give us
a full Definition when he says " Philoso=
=phical Chemistry is ye Art of dividing

all Bodies within Our power by all the Instruments within our power,, but from these words it is impossible to determine what is a Chemical Operation. for instance the Method of making Shot by dividing the Lead after fusion into small parts is really a chemical Operation — When Sugar is reduced to powder in a Mortar it is also divided into smaller parts, yet it would be as absurd to call that a Chemical Operation as the Shaving a Beard, or chipping a Block.

The great Boerhaave attempted a Definition of Chemistry. but in Reality he says little to the purpose. from his Failure in the Attempt we may conclude

that ye Task is extremely difficult.

To give then a more accurate and simple Idea of Chemistry, we must look upon it in a different Light from that in which it has been hitherto examined, by considering it as a Branch of Natural Philosophy. Nat: Philosophy is its Genus, but what is its Species? Boerhaave in his Methodo Studii Medici, says "that Science which explains ye: particular Nature of Bodies, and whereon ye Formation of those Bodies depends is a Branch of Nat: Philosophy, & is called Chemistry." — this is partly ye: Definition we are inclined to adopt. viz: Chemistry is ye: part of Natural Philosophy which treats

of the particular properties of Bodies,

— to understand w^t is meant by general and particular properties of Bodies I shall illustrate it by a few Ex=
=amples. it must be Observed that as y^e Doctrine of particular properties of Bodies belongs to Chemical, so the Doctrine of general properties of Bodies belongs to Mechanical Philosophy. For Example, Gravity is a general Property of all matter, and therefore comes under y^e Consideration of Mecha^l: Philosophy. but y^e: Ductility of Gold & y^e: Hardness of the Diamond are particular properties of particular Bodies, & therefore all under

ye Class of Chemical Philosophy. to illus-
:trate ye Above Definition further, let us
consider a Knife. the Cutting of it depends
upon its Form wch is a wedge. this Form may
be given to any Other Body. it is therefore
a general property, and to be considered as
belonging to Mechanical Philosophy. for
Gold wrought into ye same form would
cut equally as well, if ye hand wch uses it
was to press always in ye same plain wth
its Edge. but seeing that is a moral Im-
:possibility, we must make Choice of a
Substance yt will bear to be turned a little
from its perpendicular hight or position
& will return again to ye same. this pro-
:perty is called Elasticity, & is found very

greatly in Iron. the Choice then of Iron for a Knife as possessing a particular proper=ty is an Object of Philosophical Chemistry

No Other Definition y: I know of excep[t] this w:ch we have adopted can give y:e young Student an Idea or first Rule by which to distinguish what properly belongs to Chemistry. I also flatter myself y: my Definition may be applied both in Phy[sic] and Other Arts. But y: you may more fully comprehend my meaning, & be able to distinguish better y:e general from y:e particular properties of Bodies, I sh[all] delay you w:th a few more Examples.

In Physic y:e Doctrine of Stimuli is ve[ry] extensive. the Idea is taken from a Spur

In considering y^e: Animal Oeconomy we see a great variety of Stimuli, i.e. Bodies w^ch: act upon it by Irritation & Spurring. y^e: most evident kind of Stimuli are those w^ch: are sharp-pointed. but there are others whose particles we cannot examine, & are therefore ignorant how they act as Sti=mulants. of late then we have divided Stimuli into Mechanical & Chemical. - the first are those which act like Spurs w^th: their sharp-points - the second are only known by y^e: properties of y^e Bodies in which they are found. all y^e: we know of them is, that they are certain sharp irrita=ting Qualities inherent in certain Substan=ces. - all y^e: Difficulty then remaining is

to distinguish w:ch are general & w:ch are particular properties. For y:e better under=standing of this take an Example.
There is a Mixture of Chalk and Sand put into a Vessel. it is required to seperate the Mixture. I pour Water for this pur=pose upon y:e Mixture, & stir it briskly. When I cease from stirring y:e large par=ticles of Sand quickly subside, & y:e Chalk remains suspended in y:e water. if the water is then decanted it carries of the greatest part of y:e Chalk leaving the Sand at y:e Bottom of y:e Vessel. y:e Process being repeated as Often as is necessary leaves y:e Sand perfectly seperated from y:e

Chalk. if instead of water I add vinegar
or any other Acid, ye Chalk effervesces
w:th the Acid, and forms a uniform Body,
nor will ye Chalk be seperated from ye Acid
by any length of time, ye Sand at ye same
time remaining unchanged. now let
us enquire into ye Rationalia of these
different methods of performing ye Operation,
& endeavour by ye Assistance of ye Theory
we have adopted which of these Operations
can properly be called Chemical. ye Success
of ye first method depends upon Fluidity a
Property not only of water, but of Oth: of
Wine - Rum - Brandy &c &c any of w:ch
w:ch have performed ye process equally as

well as water. it depends likewise upon
ye respective Size and Weight of ye Sand
& Chalk. this Operation is then certainly
Mechanical. in ye second Operation Aci-
=dity was ye Instrument. Acidity is a
particular property, therefore ye Operation
is Chemical.

Some argue agst our pretending to
establish general and particular properties
from our not being sufficiently acquain-
=ted wth Nature to know how far parti-
=cular properties extend: & some late
Discoveries which prove yt Quicksilver
may be rendered solid, & ye hardest Diamond
liquefied seem to strengthen this Opinion
but as long as certain properties appear

in certain Bodies very constantly, such
may be reckoned proper Objects of Chemistry.

From these Examples we may ven:
ture to conclude that Chemistry is that
part of Natural Philosophy w:ch ~~teaches us~~ treats
y:e particular properties of Bodies, and
teaches us by various means to induce them
where they are not, and destroy them where
they are. —

Having now distinguished what does,
and what does not belong to Chemistry,
we shall next proceed to y:e Doctrine of this
Science; but previous to this it may be
necessary to say something of the Method
of conducting y:e Study of Chemistry w:ch

the Addition at ye same time of a few Cautions that may warn ye Tyro ag:st ye innumerable Errors yt occur in Che-mical Writers.

Dr. Shaw excited ye Study of Chemistry more perhaps than any other Man Whatsoever. but such projects as we find in Shaw Becher &c &c are carefully to be avoided; For you will find many Defects in Science, & many Difficulties in practice of which Theory is not aware.

Chemistry exercises ye Memory more than ye Judgment. Our Business must be therefore to relieve this Faculty, w.ch must be done by means of Order. For this purpose

I shall give you ye general plan wch I intend to pursue; from wch you will gain these two Advantages 1st you will be directed by it to particular parts & 2nd you will be enabled to keep in view ye Connection of the whole. ——

The Ultimate End of Chemistry is to learn ye Causes of particular properties of Bodies, & ye only means of arriving at that End is by Induction.

Every Science may be reduced to two Heads. <u>History</u>, & <u>Philosophy</u>. under ye historical part I shall deliver first an History of ye Objects of Chemistry. Secondly a general Acct of the Operations & Instruments

of Chemistry. thirdly. the Chemical History or
the Knowledge of those Facts which must
lead us to the Knowledge of Causes, or
the philosophical part of Science. Facts
must be collected under the Titles of the parti
-cular Bodies to which they belong; & the
Means pointed out by which their particu
-lar properties are discovered. together with
the manner in which they are induced or destroyed
this part of the Study is extremely useful
independant of the Causes of Qualities. &
no Person will doubt the Utility of knowing
that Antimony has an Emetic Quality
& the means whereby this Quality may be
encreased or diminished, yet we do not know

the Causes of y^e Quality. Again it is ex=
=tremely useful to know y^e Aqua Fortis
dissolves Silver, but that it has no Action
upon Gold, yet we do not know why it dis=
=solves the One, and has no Effect upon the
Other. —
In delivering the Chemical History
of Bodies, you will frequently be refer=
=red to y^e Relation of Bodies to each Other,
& to the Means by which this is discovered.
I might illustrate this by an Example,
but as I shall be Obliged to employ Terms
w^ch I have not yet explained, it will be
better understood hereAfter.
You might here naturally enquire

wh: Books are to be read? – I am sorry
to say yt upon ye Subject of Chemical
History, no Books are written wch I can
recommend to You, because they are
incorrect deficient & without Order. Nei-
-ther is there any Book yet published in wh
ye Language, or general Matter of Chemist[ry]
is preserved accurately. Even in Macquer's [Che-]
-mistry, a Book wch I would most safely re-
-commend to your Perusal I shall much
Oftener have Occasion to refer You to th[e]
Errors than to the Excellencies of ye Auth[or]
– its chief Use is to show ye common Meth[od]
of conducting Chemical Processes.

The first part of our Plan wi[ll]

contain two principal parts. 1:st an Explanation of ye Language of Chemistry 2:nd an Acc:t of the Objects of Chemistry. This part you must consider not only as applicable to Chemistry, but likewise as a Compendium of Natural History.

The Second part of our plan will also contain two principal Heads
1:st the Rules of practise
2:nd An Introduction to ye Theory of Che=
=mistry. —— The Order of the Third part requires a particular Explanation. I shall therefore defer speaking of it at present. —

We shall endeavour in explaining the Terms of Chemistry to affix proper & distinct

Ideas thereto. a needfull Lesson this! whi
cannot be learned from any Glossary or
Dictionary. if upon any Occasion One
single Term occurs wch does not give you
clear Idea, rest not. till by considering
your Notes - reflecting on wt you hear,
enquiring among your fellow Students y
become perfectly acquainted wth its meanin

It will be probably expected yt I shou
deliver Something concerning ye Doctrine
Qualities: But I must own myself d
=tical in this Affair. Besides in ye presen
State of Chemical Knowledge it will b
impossible to render it compleat. I resol
however in this Course to give ye History
ye chief Article of Qualities viz Fire

Which will be found to have some Con=
=nection & to throw some Light upon ye
Others. You must in this, as well as in
Other Subjects indulge me in giving much
Theory. For tho' no Body would recommend
a Wontonness of Theory less than myself,
yet I must be Advocate for its Utility under
proper Restrictions. it is a most power=
=ful Means of exciting us to Experiments
& consequently ye Knowledge of Facts. Nothing
will more enable us to detect Fallacy
& Sophism than a Discussion of theoretical
Opinions.

I shall proceed to give you some Advice
wth Regard to your Conduct in Theoretical
Inquiries; for I shall not only endeavour
to make you acquainted wth Chemistry as

applicable to ye purposes of ye Physician,
but of the Philosopher also. we shall find
likewise that ye ye Knowledge of Facts
& Practise will be considerably enlarg
by ye means employed for theoretical In-
-quiries. But to enable you to follo
me, & to make any Advances your
-selves in Chemical ~~Knowledge~~ Philo-
-sphy much preparatory Knowledge
necessary.

Logic is a very necessary part of
introductory Learning. By Logic
mean ye Analysis of ye human Mind
such as may be found in Mr Locke's
excellent Treatise upon ye human
~~Un~~Understanding. This is not only

necessary in Chemistry, but also in every
Other Science where there is Danger of Error.
—I cannot but lament y^e y^e Students
of Medicine in this university are not
Obliged to go thro' certain preparatory
Branches of Learning: for many of the
Gentlemen who come here are so igno:
:rant in this Respect, that it is imposi:
:ble for them to make any tollerable pro:
:gress in Medicine. in recommending
y^e Study of Logic, if we could venture we
would recommend it in a particular
Form, I mean y^e Study of Scepticism. not
an Obstinate Disbelief of every thing. and
every Fact, but y^e kind of Scepticism

which ye Poet calls
"the slow consenting Academic Doubt"
The most common Error in our Reasoning
proceeds from our assuming false premises
- these in Natural philosophy and parti-
-cularly in Chemistry but be Obtained
by Induction. Since we have no Books on
this Subject which I can recommend to You
I shall endeavour to lay down some Rules
for assisting You in ye Collection of
Facts. I shall divide these Rules into
two Heads
1st. the Choice of Facts.
2nd. Mechanical Rules concerning ye Manner
of disposing them.
We must collect Facts by putting them

in writing. not Only from Our own Experience but from Books. all Facts which we find in Books ye: do not deserve a second Reading must be transcribed into Our own papers. but then ye greatest Caution is necessary to collect none but true Facts. for many writings especially of the Alchemists contain nothing but ye most palpable Falshoods. these Fallacies are considerably owing to ye: Difficulty of making nice Experiments, & of applying our Senses to ye: Examination. thus ye Danger of making Ether (wch: has ye Object of ye: Chemists Attention ever since ye Year 1732) has never been Obviated 'till within these

two Years. Again Dr. Arbuthnot some-
-time Ago settled ye Heat of ye human
Body at 82° of Farenh: Thermom.: but
it has since been raised to 98° or 100°.

Besides Authors are liable to relate false
Facts thro' mistake. thus for Example Mr.
Geoffroy has told us ye Vol: Alkali has
a Stronger Attraction to Acids than Ab:
-sorbent Earths, Whereas ye contrary is
now found Out to be true. You must
be especially upon your Guard against
such Facts as are deduced from Theory. for
when Macquer says ye Salt is a Composition
of Earth and Water, he does not assert it from
his own Experience. but from his Theoretical

Opinion. he again affirms upon the same Authority that Metal: Sub: are for-med of a vitrifiable Earth & Phlogiston, which from Experiment you will find to be false.

The concurrent Testimonies of a great Number of Authors must surely have considerable weight, but even here we are liable to Deception, since Facts have been received as Truths from a Series of Authors implicitly, many of which when put to ye Test of Experiment have been found to be false.

Microscopical Observations are always to be in some Degree distrusted. for instance Leeuwenhoecks Discoveries concerning the

Globules of Blood have long been received as Truths, but Mr. Senac says they are lenticular & Dr. Haller that they are sperical.

All Facts wch: are said to be universal are likewise to be suspected. General principles are certainly very necessary, but at ye: same time very difficult to be esta=blished, & always to be received wth: Diffidence. — thus Effervescent mixtures have all been supposed to produce Heat, but we know now that some of them produce Cold.

We are very liable to Mistakes in assig=ning Causes for Phænomena on a Sup=position that certain Circumstances al=ways produce certain Effects. Eg: air passing thro a great Degree of Heat was long pronounced to be deleterious to Anima

even after it was reduced to its ordinary Temperature, but this is a mistake, for Air passing thro' a Tube that is red hot is not rendered un fit for Respiration, tho' it be=comes highly deleterious after passing thro' burning Bodies.

Authors are sometimes mistaken in assigning One Cause for an Effect which several conspired to produce. thus it has been asserted y^t y^e Freezing of water was only owing to Cold, but water in its fluid State contains a great Quantity of Air. & it must be in a great measure deprived of this Air before Freezing can take place.

we find considerable Inconveniences also from not knowing y^e particular Cir=cumstances

of Facts, which Authors frequently neglect to mention. for Example we are told y: Brass is formed of a Mixture of Zinc & Copper, yet they do not say whether any Effervescence succeeds ye Mixture. Whether Heat or Cold is produced - Whether there is any Separation of parts - Whether ye Speci=fic Gravity is lessened, or encreased - Whe=ther there is any Alteration in ye Appea=rance of their Texture - & lastly whether any Change takes place in ye Fusibility of Either. - From these Examples we may conclude that there is hardly any One Fact sufficiently pursued for ye purposes of Philo=sophy or Arts. ——

Of the Objects of Chemistry

all y^e particular Bodies w^ch: are the Objects of Chemistry may be referred to One of these ~~three~~ six Forms. Viz:

1^st: Saline.
2^d: Inflamable
3^d: Metallic
4^th: Earthy
5 Watery
6^th: Aerial. except perhaps certain Animal and vegitable Substances w^ch: as they cannot w^th: propriety be reckoned among any of these may constitute a
7^th: Form.

I shall explain by a ~~Diffs~~ Definition of each wherein consists y^e: Difference of

the six Forms. but you must not expect my Definitions to be entirely perfect since I shall only endeavour to give you such general Ideas of their names as may serve Our present purpose, & enable you hereafter to enter upon an Exa=
=mination of the Chemical Bodies.

I shall now proceed in ye Order of Natu=
=ralists, distinguishing Bodies into Genera & Species.

Saline Bodies

These are sapid & miscible wth water. so are likewise ye next Class of Bodies. we must therefore have Recourse to a 3d disting Character. & that a negative One. Def:
" Saline Bodies are therefore sapid. miscib

w:^th^ Water and not inflamable.

Inflamable Bodies

The Definition of these is perhaps more perfect, since the Explanation of the Term inflamable is a Definition of the Class. Def: — A Body is Inflamable if, when applied to burning Fuel, it also begins (& tho' withdrawn from y^e^ Contact) continues to burn w:^th^ an obvious Con=sumption of the whole, or part of its Sub=stance receiving on its Surface a lumi=nous vapour called Flame. The only Exception I know to this Definition is Charcoal, w:^ch^ tho' properly belonging to y^e^ Class of Inflamables does not produce

any Flame.

Metallic Substances

Def: "These are shining Opake insipid Bodies, - not soluble in water - not inflammable - but when exposed to certain degrees of Heat are fusible, & recover after cooling their Original Texture."

Earthy Bodies

Def: "These are dry insipid - insoluble in water - not inflamable or fusable in the Fire" — no pure Earth is fusable except w:th ye Addition of foreign matter. Chemists however have divided them into fusable & not fusable. that you may not then be embarrassed w:th these Terms. I shall

add,, if fusable they do not concrete into ye same Form as before but are converted more or less into Glass.

Watery Bodies

Def: ,, Water is an insipid, pellucid Body which in ye Ordinary Temperature of ye Air is fluid, but when exposed to 32°. of Farenheits Thermometer becomes solid & friable, or if exposed to 212° of Heat in the same Thermom: is dissipated in vapour.

Aerial Bodies

Def: ,, Air is a thin elastic Fluid. both which properties of Elasticity & Fluidity it pre= =serves independant of all Temperatures.,,

We shall now proceed to explain the

Division of ye several Forms beginning wth the Saline. I have employed ye word Form, because ye various Bodies mentioned are not permanent, but change their particular Qualities by uniting wth Other Substances or by some Other Means.

Saline Bodies are either Simple or Compound. the Simple Bodies are such as preserve a uniform Appearance of Texture in ye most minute parts which we can examin. the term Simple is also applied to ye principal Ingredients of a Compound. altho' some of these Ingredients may perhaps be resolved

into Others w:ch compose them. Those Bodies are called Compound w:ch are formed of Parts possessing different properties.

The Simple Salts are either Acid or Alkali.

- Acids have a peculiar Taste called sour, changing Syrrup of Violets or Other blue vegi=
=table Juices into a red Colour.

Alkalies are sapid, soluble in water, effer=
=vescing when combined w:th Acids & changing the blue Colour of vegitables into a green.

Acids are the Vitriolic, Nitrous, Muria=
=tic & Vegitable so called from ye Substan=
=ces which usually afford them. There may be Other Species of Acid, but these mentio=
=ned are most generally known.

Alkalies are of two kinds Only viz

Fixt, and Volatile. the former have very little Odour, & will sustain a considerable Degree of Heat without Dissipation. the latter emit a very pungent Odour, and readily exhale in a very gentle Heat.

Neutral Salts are formed by a Mixture of Acid and Alkali in a certain proportion & have been called two Sales Salsi as compos=posed of two Salts. the Term Neutral applied because they possess ye Properties of neither Ingredient before Mixture, but are a tertium quid. thus Nitre which is a neutral Salt composed of Nitrous Acid, and fixt Alkali does not effervesce with ye same Acid, nor change ye Syrup of Violets red or green.

Blue Vitriol is an Example of

a Metallic, and Alum of an Earthy Salt. — Macquer very improperly calls Alum a neutral Salt, because it is not composed of an Alkali. nor are ye properties of its Acid changed. for Alum applied to ye Syrrup of Violets changes its Colour to a red.

Inflamable Bodies. of these there are not so many Species as we might at first Sight suppose. their Inflamability generally depending upon some parti=
=cular Ingredient. thus if we extract ye Oil from wood — the Sulphur of Pitcoal, or the Alkohol of wine. the Residuum of these several Bodies will become incapa=
=ble of Inflamation, & perhaps to these three Forms of Oil, Sulphur & ardent Spirit we

may, almost without Exception refer y^e
Inflamability of all Bodies. These three
Forms are again supposed to depend
upon One simple Phlogiston to which
y^e Inflammability of all Bodies wh
-ever ~~may~~ are chiefly to be attributed.

Oil

This is properly of a fluid Form, except
When it is coagulated or entangled by
y^e Interposition of some Other Body. I shall
therefore define it to be an inflamable fluid
not miscible with water.

Sulphur is a dry solid
inflamable Body not soluble in water.

Ardent Spirit is an inflam
-able Fluid readily miscible w.^th water.

Oils are of three kinds viz: Animal. vegitable. and fossil.

The Animal & vegitable are subdivided into expressed. Essential & Empyreumatic. The Term expressed is by no means proper or universal. for many of ye Oils called ~~Expressed~~ Essential may likewise be Obtained by Expression. we shall therefore define ye Expressed Oils to be insipid, ino: :dorous, and not soluble in Ardent Spirit. to these belong Fats. Gums & wax.

Essential Oils have an acrid Taste- are soluble in Spirit of wine, and retain more or less of the Taste and Odour of the Subject from which they are extracted. Essential Oils are very generally tho' not

altogether peculiar to y^e^ Vegitable King-
-dom, for y^e^ Animal Substances Castor
& Musk are of this Sort. to these Oils
may be referred Balsams & Resins. these
do not differ but in Consistence; for when
Balsams become indurated by Exposure
to y^e^ Sun or Air they are called Resins. the
Term Essential does not exclude all the
Expressed Oils, for the Expressed Oil of
Mace (so called from y^e^ Method by which
it is Obtained) retains y^e^ Taste and Odour
of the Subject from which it is extracted,
is therefore with y^e^ strictest propriety ca
Essential Oil.

Empyreumatic Oils are acrid & soluble
in Ardent Spirit. they do not retain the

Taste nor Odour of y^e: Subject from which they are Obtained, but acquire a peculiar burnt Smell called Empyreuma, & hence their name. to this Head belongs Tar.

Fossil Oils of this there is but One Species w^ch is called by y^e: Naturalists Naptha when it is become very clear and volatile. when less pure it is called Petrolium. when thick like a Balsam it is called Pisselion or Barbadoes Tar. when hard of the Con=sistence of Rosin it is called Asphaltum or Bitumen Judaicum. this Oil may be distinguished from y^e Expressed by its Taste and Odour, & from y^e Essential & Empyreumatic by y^e: peculiarity of its Taste and Odour w^ch: can Only be learned by

Experience. we may therefore define it to be an Oil of a peculiar Taste & Odour not readily soluble in Ardent Spirits.

There are various fossil Inflamables which have been called Bitumens, but ye Term Bituminous cannot be properly applied to any Bodies, except those wch owe their Inflammability to fossil Oil.

to the Head of Oils belongs Æther which is an Oily Fluid extremely inflammable volatile, and of a peculiar Odour & Taste not to be met wth in any Other Body, and not miscible wth water.

Sulphur is of one kind Only, called in England Brimstone, but in latin it

distinguished by ye Epithet Minerale.
to distinguish it from an inflammable
principle called by ye latin & French
writers Sulphur.

Ardent Spirit. the word is frequently
applied with ye utmost impropriety to the
liquids as Spts of Nitre Vitriol &c, & even
to such of ye Essential Oils as are of very
great Tenuity as Sp. Terebinth &c. now to
avoid Confusion we ought to apply ye
Term only to such Spirit as is Obtained
from vinous Substances, which in its purest
State is called by ye Chemists Alkohol.

Metallic Bodies.

To the former Definition of them we may
add yt they are Bodies of ye greatest Speci-
=fic

Gravity in Nature. they are divided into Metals. and Semimetals.

The Metals are { Gold. Silver
Lead. Tin.
Copper. Iron
& Quick=Silver.

The two first of these are called noble or perfect. the five last Base or imperfect - this Distinction has arisen from ye extraordinary Resistance wch ye former make to ye Action of Fire & Air. it has been supposed yt Gold could bear ye most intense Heat without being changed but later Experiments discover yt in the Focus of a large burning Glass Gold may be quickly destroyed. Gold & Silver however have both been found to withstand ye Heat of a ~~large~~ Glass=House Furnace many

weeks without any sensible Change.

Dr. Boerhaave averred yt if any Body could be of equal Specific Gravity it wd possess all Other Properties of Gold - but this is also found to be a Mistake, for Platina which has None of ye Proper=ties of Gold is of equal or perhaps grea=ter Specific Gravity.

I have added Quick-silver to ye Metals because it is found yt under a certain Degree of Cold it becomes ductile, mal=leable & solid, and these properties of Duc=tility & Malleability distinguish a Metal from a Semimetal.

The Semimetals are { Zinc - Antimony
Bismuth - Arsenic
Platina - Cobalt &
Nikel.

These are distinguished from ye Metals
by their friable Texture. but Zinc having
been found to retain some Degree of
Malleability has given Occasion for Au-
=thors to divide Metal: Sub: into Malle
=able, Semimalleable & friable.

Naturalists have long been doubtful
in wh: Class to place Arsenic. Dr Boerh
enumerates it among ye: Sulphurs. but
now we know yt ye Substances to which
ye: name has been applied have a Metal
matter for their Basis.

Metal: Sub: are generally found in
a State of Ore. i.e. blended per minima
wth Other Bodies which most frequently are
Sulphur, Arsenic or both. When these are

united w:th Earthy Matters, ~~they~~ as to form
a heterogeneous Aggregate, such Ones
are said to be inherent in Matrices.

Earthy Bodies

These are divided into Absorbent - Chrys=
=talline - Argillacious & Talky.

Absorbent Earths are very improperly
called Alkaline, because they do not pos=
=sess any of y:e Qualities of Alkalies,
except ~~that~~ of destroying Acids. y:e Term
Calcarious is also very improperly ap=
=plied to them, because they are not all
convertable into Quick-Lime. these
Earths are soluble in Acids.

Chrystaline Bodies are not at all
acted upon by Acids. - they are friable &

of such Hardness as to strike Fire with Steel. these are ye Substances com=monly employed for making Glass by means of fixt Alkali which renders them fusable. from this Circumstance they have been improperly called Vitres=cent: for without ye Addition of an Alkali they are no more vitrescent tha Other Earths, and indeed all of them by proper Addition become vitrescent. Besides ye Mountain Chrystal, whence the Earth took its name, every kind of precious Stone, Flint or Sand belongs to this Class.

Argillacious Earths are not readily or Obviously soluble in Acids. they are

not hard eno' to strike Fire w.th Steel : if
broken down & formed by Water into a
Paste, they become viscid & ductile. this
Paste exposed to ye Fire acquires very
great Hardness. these Characters are
sufficient to distinguish ye Argilla=
=cious from ye Other Classes of Earths.
but we may also add ye: they absorb
Water w.th a great Increase of Bulk.

Under the Head of Earths I comprehend
all those Substances called Stones: Mr.
Reameur thinks he has found an accu=
=rate Distinction between Earths & Stones
viz. that ye Earths swell and Absorb water;
but this a property of ye: Argillacious Only.
- in my Definition of Argillacious

Earths. I have said y^t they are not Ob-
-viously soluble in Acids, on Acc^t of some
late Discoveries by which we are inform'd
that by very strong Acids under a certain
Management, they may be resolved
y^e Crystaline & Absorbent, so y^t we are
wrong in enumerating four kinds of
simple Earths.

Talky Earths are found disposed in
thin plates or Fibres. they suffer no Chang
from y^e Action of Fire or Acids, neither
they become viscid or harden when mad
into a Paste. of this Class is y^e Asbestos
is compound of Fibres y^t by proper Ma-
-nagement may be made into Cloath
or Paper. these must be freed from Filth

and Old writing by burning instead of
washing. Dr. Brookman a German has
published a Book upon ye Asbestos, &
a Copy printed on ye Substance hi pre-
-sented to a German Prince.

Gypseous Bodies are not soluble in Acids,
nor yet hard eno' to Strike Fire wth Steel.
- When mixt wth water they do not become
ductile or viscid, but acquire a stony Hardness.
- exposed to Fire they fall to powder wch has
not ye Properties of Quick-Lime. These
Bodies are disposed in Laminæ or Fibres,
& have been classed among ye Earths, but
they are undoubtedly saline Substances
commonly called Sellinites wch are formed
by a Species of Calcarious Earth & Vitri-
-olic

lixiv.

Of watery Bodies

There is but one Species of water perhaps in nature of which we have already given a general Definition. we are ne[ver] able to examin this perfectly freed from Other matters. When water is insipi[d] & without Odour it is called Comm[on] — But when it issues from ye Bowells [of] the Earth so strongly impregnated wi[th] foreign matters as to acquire a Tast[e] & Odour wch: are Obvious to our Senses it is then called Mineral.

Naturalists have commonly confined themselves to ye 5 preceding Terms. The

hitherto pursued their plan, but now I shall venture to add a 6th the Aerial.

Aerial Bodies

Air wherever it is met with in a seperate State is always Elastic. Its particles have ye power of repelling each Other. I think there is some Reason to suspect that Air is of two distinct Species, which I shall call Common & Mephitic. the Former is indispensably necessary to ye ~~support~~ Life of Animals & ye Support of Flame. whereas ye latter is extremely deleterious to Animal Life & suddenly extinguishes a Flame applied to it.

The Distinctions wch I have made between ye two Fluids Air & water are

sufficiently acurate. we may howev
add ye water is very nearly incompressib
and is only capable of lateral Motion
Gravi- ~~Cap~~tation to ye Center: Whereas Air
a very Elastic Fluid compressible in
proportion to ye Force applied, and th
parts also by repelling also expand
each Other quoquoversum.

Now to conclude this Subject of ye Obj-
of Chemistry I must Observe that ye pa
-ticular Character of Bodies which we hav
given are not sufficiently acurate, n
indeed can we expect Definitions to be
quite perfect, since ye Bodies to be defin
are unsteady in their Qualities. Thu
we find ye water may be converted

into Earth or vapour — air may loose its Elasticity and become fixt — that Quicksilver may be rendered solid, & Gold itself which hitherto has been looked upon as permanently fixt, dissipated in Fume by ye Heat of a Burning Glass.

We shall now add some general Ob:servations on the Objects of Chemistry.

Many Philosophers have tho't ye Matter was divisible ad Infinitum. Others suppose that there are Limits set to ye Divisibility of Matter, at least by any powers in Our System. the following Argument taken from ye Appearance of Nature is not un:favourable to this Hypothesis. we Observe ye Animal and Vegitable Bodies continue

to perish & to be again renewed. their
Destruction as far as we can see depend
upon a Seperation of these parts. now if
ultimate particles of Bodies are liable
to Change and Division, we should surel
see a proportionable Change in ye Bodie
wch they constitute: whereas we find tha
Animals & vegitables have continued fr
ye Creation perhaps to succeed each Oth
under ye same Form & Appearance.
Isaac Newton illustrates this Opinion
any Example from ye works of art. if say
they an Arch of a given Size be built
Stones properly adapted to it, it will n
be difficult to destroy & again rebuil
provided ye Stones remain unchange

but if the Stones by any means become
altered either in Shape or Magnitude, it
will be impossible to produce an Arch of the
same Size precisely with the former out of
such Materials.

To consider therefore the Objects of Chemistry
more generally we must look upon them
all as Corporeal Substances which possess par=
=ticular Properties. These are either Elements
or Mixts.

Elements or Atoms as they were stiled by
the Greek Philosophers are the minute par=
=ticles of Matter which are no ways changeable
or divisible by any powers in Our System.
– these Elementary parts of Matter are of
different kinds and Quality; for if the dis=
=ple

Elements were all of One kind there could be no Mixts in Nature, but every Mass of Matter would be a simple Ag-gregate. Mixts therefore are formed of two or more Elements. these Atoms in a Seperate State are not Objects of our Senses. -Chemists however have occasioned much Confusion, by calling ye most minute parts of matter ye can be examined by human Art Elements, Whereas Mixts are perhaps ye most simple Bodies wch we can possibly examine. it has therefore been thought necessary to divide Elements into

1st Physical Otherwise named Atoms. or

2nd Chemical, commonly named The Princip

The former of these are rather inferred tha

demonstrated, & perhaps when mixt they
Often evade our Senses. we shall illustrate
this by ye following Example. a Grain of
musk will perfume every part of a large
Room; that is every Portion of Space in ye
Room will be filled wth Odoriferous parti-
-cles, and this will continue for several
Days without any sensible Diminution of
ye musk either in Bulk or Weight. now we
cannot suppose yt these particles are phy-
-sical Elements, but rather that they are
composed of two or more of these, notwith-
-standing their minuteness.

Dr. Sthal & his Followers have conside-
-red Mixts as compos'd of simple Elements.
these have been called also Secondary

Principles. two of these Mixt form a Com=pound. two or more Compounds a De=compound. two or more of these form a Superdecompound &c &c.

There is a Foundation in Nature for th[e] Terms, but I shall not adhere to them du=ring this Course, because it is extremely rare that we can determine yᵉ exact Degre[e] of Composition which takes place in any Body. this becomes more uncertain [bein]g perhaps all Objects that are Obvious to ou[r] Senses are Mixts or Compounds. I shall therefore use yᵉ Term Mixt or Compound fo[r] every Body which is divisible into parts of dissimilar Qualities. —

all Sensible Bodies may be consider[ed]

as Mixts, that may be resolved into con-stituent parts, or as Aggregates that may be divided into integrant parts.

The Resolution of the parts of a Mixt implies a Chemical, and ye Division of the parts of an ~~Integrant~~ Aggregate a Mecha-nical Operation. to illustrate our Ideas of these Terms let us take ye following Example. Nitre considered as a Mixt may be resolved chemically into its two constituent parts Acid and Alkali, when no Appearance of ye Neutral will be left. Again we may consider a Mass of Nitre as composed of Particles containing such a Proportion of Acid and Alkali, as that each particle shall be a perfect Neutral.

such Particles are called ye Integ: parts
i e parts wch if united into a collective M[illegible]
would form a perfect Nitre. if therefore
Portion of Nitre be reduced by mecha
=nical means to parts of such minuteness
as ye any further Division would cause a
Separation of its constituent parts Aci[d]
Alkali, the Nitre may be then said to be
divided into its integrant parts. an Ag
=gregate may be looked upon as an Unit
to any Number of Individuals or Integ
Parts.

To distinguish an Aggragate from a
Mixt. it is ene' to know ye Number of
parts of their Connection. we must ad[d]
ye ye parts of ye former are all perfectly si[mi]
=lar

While those of the latter are dissimilar;
-yet even this is not Absolute, for when Gold
is intimately dispersed thro' a Stone the
Mass must be considered as an Aggre:
:gate, tho' it contains various parts.
we may likewise say y^t: in Order to
form a Mixt, the constituent parts
should be perfectly blended w: each
Other (as we say) per minima.

This much has been said to enable
the young Student fully to comprehend
y^e meaning of the Terms, & to establish
distinguishing Characters, whereby we
might know w: are and w: are not Che:
:mical

Operations. the Divison of ye parts of Aggregates is Only reckoned Che-
-mical when particular Methods are employed.

Mr. Venelle confines ye Operations of Chemistry to ye Resolution & Com-
-position of Bodies, but this is not sufficiently extensive. in ye Sublima-
-tion of Sulphur for Example no Resolut
or Composition takes place, & yet no
Body will deny that this is a Chemi-
-cal Operation.

Dr. Sthal & those of his School have considered Bodies as Mixts or Tests.
Mixts he considers as Above described

but he does not call Bodies Texts un:
:less they have peculiar Properties
arising from their Texture & ye Arrange=
:ment of their Parts. include Antimony
the Parts are disposed in Lines resembling
Needles: hence we see a peculiar Pro:
:perty arising from a certain Arrange=
:ment of parts. a Tube of Lead from
ye Arrangement of its parts is what we
call a Text, or as Others have termed
it an Organic Body: but Glass wood
or any other metal &c would be capable
of receiving ye Form of a Tube as well

as Lead; therefore y^e: properties of Texts
depend upon y^e: general Properties
of Bodies. and consequently are not
y^e Objects of the Chemical but of the
Mechanical Philosophy.

Of the Operations of Chemistry

We now proceed to a general view of the Operations of Chemistry. in ye prosecution of this Subject I shall en=deavour to make you acquainted wth ye Terms relating to ye Operations, and general Rules for ye practice of Chemis=try: together wth an Introduction to ye Theory of Chemistry - of Chemical Ope=rations and ye Chemical properties of Bodies. I shall begin by laying down ye following Fundamental Prin=ciple

to wh: perhaps there are very few Ex-
-ceptions in Nature viz: — that
all ye: Changes. of ye Qualities of
Bodies produced by Chemistry are
all produced by Combination and
Seperation. under which Terms I
comprehend Rarefaction & Conden-
-sation. this is proved by Induction, &
may be rendered very probable à priori
— To illustrate this proposition I shall
mention ye process for decomposing and
again combining ye: constituent
parts of Nitre, and to this Instance
I shall occasionally refer during this

part of ye Course. Nitre applied to bur-
-ning Fuel is decomposed. i.e its Acid
flies off by ye Deflagration, & ye Alkali
remains alone. if to this Alkali a por-
-tion of Nitrous Acid is added an Effervescence
will take place, and if ye Acid be exactly
saturated wth ye Alkali a Substance will be
deposited wch we shall find to be perfect Nitre.
This Experiment may be repeated ad
Infinitum by deflagrating ye new formed
Mass of Nitre, and then by adding
fresh portions of Acid to ye Alkaline Re-
-siduum. now let us examine ye pro-
-perties of ye constituent parts of Nitre.
& then ye neutral wch these produce in

Combination.

	Acid	Neutral	Alkali
	Fluid	Solid	Deliquescent
	Volatile	Fixed	Fixed
	Corrosive	Mild	Corrosive
with water	Heating	Cooling	Heating
with Fire	Quenching –	Excit.g Inflam.n –	Quenching.

The Change of Qualities in these Bodi[es] seems evidently to depend upon Combin[a]-tion & Seperation; tho' we shall hereaft[er] perhaps meet wth some Substances who[se] Qualities cannot be positively referred [to] these Causes; because ye Matter dissipate[d] or added may not be Obvious to our Sense[s] E.G. From 100℔ of Lead 110℔ of Minium ma[y] be Obtained notwithstanding ye parts w[hich] are dissipated in ye Operation. here we Obv[...]

a manifest Increase of Weight, without being Able to discover any Addition whatsoever. But if our Proposition is found true in 99 Cases of 100, we may be allowed to conclude from Analogy y^t it takes place in the hundredth. — Again if there be any physical Elements, or insecable Atoms, the Qualities of Bodies must depend upon the Composition or Resolution of these; & on this Hypothesis our Proposition will be founded. —

There may be Cases where neither a Com:position of discrete, nor of concrete Bodies takes place, but only a Change in the Position of Parts; E.g. the Mephitic Air discharged & Absorbed again in y^e Venous

Fermentation. yet even here we may Observe a Separation of parts must precede the Change of their Position. —

From what has been said, the Definition of Chemistry I formerly mentioned, as being a commonly received One viz: the Chemistry is y^e Art of combining & Separa-ting Bodies" will appear very proper but it is too general and not sufficiently evident.

Having thus endeavoured to establish our general Proposition, I shall proceed to make some Remarks upon it as the foun-dation of Chemistry. and wth a view to exp this y^e better, I shall mention different

Hypotheses concerning y^e Origin of the Qualities of Bodies.

The Peripateticks maintain y^e Doctrine of Substantial Forms. whence they derive y^e Qualities of Bodies independant of their Texture & Combination of their Atomical parts. W^th Regard to y^e Doctrine of Substantial Forms, it is faulty in this, that it infers y^e Doctrine of Qualities. of which as they relate to physical ~~Causes~~ Elements we must be extremely ignorant, for the most subtile & minute Bodies may be shewn to be Compounds for the most part, & sometimes perhaps Decompounds.

I think every Experiment seems to be

most favourable to ye Doctrine of the Corpusculanian Philosophers. for Examp let us examin Nitre and its constituent Parts, neither of which we can suspect of being Elementary Bodies. we find the Acid fluid - the Nitre solid - the Alkali deliquescent - the Acid Corrosive - the Nitre mild - the Alkali Corrosive &c. Here we see two Bodies Acid & Alkali produ-cing a tertium Quid differing from Both. now supposing ye ye Acid and Alkali derived their Qualities from Substan-tial Forms, can we conceive any Reason why these Qualities should not be transf to the Neutral?

upon the Other Hypothesis we may

suppose that upon ye Addition of ye Acid & the Alkali an entire Change in ye Arrange=ment of their Parts takes place; from whence it is easy to imagin new Properties may arise in the Neutral. in short all our views lead us to speak of particular Qua=lities in the particular Texture of ye Mixts in which they reside, unless we can seperate that part from ye Mixt which gives it its particular Quality. for Instance Wood is an inflamable Body. its Inflammability depending upon its Oil, which may be seperated from it. But this is Only carrying ye Question One step further. for we may next enquire from whence proceeds this Inflam:

in the Oil? In a Mixt however in which ye Qualities of the Ingredients do appear we cannot always refer them to ye Ingredi-ents; for Nitre wch is composed of two pow-erfull Antisepticks Acid and Alkali is it Self less so. Whereas One would suspect from the Doctrine of Qualities that it Should be more Antiseptic. It is certainly more pro-bable that ye Antiseptic Quality of Nitre does not depend upon ye same Quality in ye Ingredients but upon ye particular Com-bination of them in forming ye Nitre ie upon ye particular Texture of the Nitre. Again if to a Quantity of the Syrup of Violets turned red by an Acid, I added a Quan-tity of the same turned Green by Vol: Alkali

(provided ye Acid and Alkali be sufficient
exactly to saturate each Other) what will
be the Result of this Mixture? - will the
Mixture retain ye Colour of ye Ingredients
& consequently be a Colour compounded
of green and Red? - no - the Acid &
Alkali mutually destroying each Others
Texture, and ye power by which they acted
upon the Syrrup, will suffer ye Syrrup to
regain its former Texture, and consequently
its blue Colour which depended upon its
Original Texture. ——

I come now in the next place to Observe
this ~~Phi~~ Corpuscularian Doctrine has in
its Turn been much Abused. many who

have espoused this Doctrine have imagined that ye different Properties of Elements depended on ye particular Size & Form of Each, and ye therefore all ye different Compounds resulted from a variety of Combinations of these Elements; as several Squares make a Cube - two Cubes a Parallelopiped &c. but this Notion is liable to many Objections which have given Occasion of Triumph to ye Opposite Sect it is not sufficient to suppose a Probability of demonstrating ye Existence of ~~such~~ such Elements or Corpuscules; but before Conclusions can be drawn, Demonstration must be actually Obtained.

We shall adopt a more proper

Scheme to lead us to the Theory of par:
:ticular Qualities by considering —

What Qualities belong to Bodies
as Aggregates, or to constituent parts.

What Disposition Bodies have to
unite w:th each Other. thus Vitriolic Acid
and fixed vegitable Alkali unite readily
w:th water in a Seperate State; but Vitrio:
:lated Tartar w:ch is formed of those two is
of difficult Solution: —

The Qualities of Aggregates, and the
modes of Aggregation consist in some measure
between Heat, and the particles of Matter. —
— it is even probable that all y:e different
kinds of Matter may be reduced to two,

viz: the Matter of Heat, or an Elastic Matter which seems to have a repul=sive power, and ye kind of Matter wch has the power of Attraction, or perhaps we might go further, and suppose that it is perfectly inert.

I proceed now to Another principal application of our proposition concerning the Operations of Chemistry viz: as it re=lates to the particular Operations.

The Combinations of Bodies in Chemi=try depends upon Attraction, & this is ye Only Property I can perceive in Bodies which does not depend upon their par=ticular Texture. if we examine the

particular State of Bodies when Attrac-
-tion takes place, we shall find it to be
Fluidity. — Combination therefore
depends upon Attraction, & this upon
Fluidity, w.ch being liquid or Elastic is
employed in Solution, Fusion & Exhalation.

The Term Attraction here employed has
been y.e Foundation of Endless Debates
among Philosophers. we shall first there-
-fore endeavour to affix y.e precise Mea-
-ning that we would have it imply.

Every Tendency that we can perceive
in different Bodies to approach Each Other
and then remain in a State of Coherence
has been called Attraction, & of this there
are several Species. a Stone drop'd from

a Weight endeavours to make its way to the Centre of the Earth, and y^e Planets if not restrained by another Cause would drop into the Sun. This is called the Attraction of Gravitation.

The Tendency of a peice of Iron, and a Load Stone to approach each Other is called the Attraction of Magnetism.

There is likewise an Attraction of Electricity which may be excited by various means, as by rubbing Glass Amber-wax &c. —

Two Globules of Quick-silver upon a plane, or two Drops of Oil swimming upon water being brought near each

Other, shew a mutual Tendency to unite. wch Tendency is called ye Attraction of Cohesion, and this Term we shall have more Occasion to employ hereafter. —

with Respect to all ye modes we have mentioned, the Term Attraction is only applied to signify ye general Fact. this is ye Sense in which Sir Isaac Newton employs ye Term not saying whether ye Fact proceeds from some power exerted by ye Bodies attracted, or from their being pushed together by some external Force. Some say this Attraction is ye immediate Act of the Creator, but this way of reasoning would soon put an End to all philosophical Inquiries. thus when ye:

Properties of the Air were not so well under=stood as at present, the established Doc=trine of Natures Abhorring a Vacuum gave a considerable Check to ye further Enquiries concerning ye Phenomena of ye Fluid. — The Sense in which we would always employ ye Term Attraction will be rather to express ye Operation than ye Modus Operandi.

Chemical Combinations depend upon ye Attraction of Cohesion. the Chemist only puts ye Bodies he would combine in a State most necessary for the Exertion of this Property, which generally takes place in a certain Degree of Con=tiguity only. it seems to depend also

upon ye Figure of ye parts of ye Bodies in Contact. this Notion is favoured by a simple Experiment. if you take two Hemispheres whose flat Surfaces are well polished, and press them strongly together, they will adhere pretty firmly, & this Adhesion will be in proportion to ye Smoothness of their Surfaces. but wn we have used our utmost Skill to give two Substances a perfect polish, that ye greater Number of Parts may be brought into Contact, we find yt they never will cohere so perfectly as when a Fluid is interposed. this Circum=
=stance is a further Confirmation of wt I

hinted at before, i.e. ye Fluidity is ye only means of giving ye Contiguety which is necessary for ye Attraction of Cohesion.

- But perhaps this Contiguity is not ye only Cause of Cohesion. there is proba=bly something else disposing all Bodies solid and fluid to unite more or less wth each Other. May not Elec=trical Attraction serve this purpose?

- I cannot venture at present to discuss this Subject: these Facts however are well worth Observation that all ye Liquids we are acquainted with are Non-Electrics and all ye Solids (Metallic Substances

excepted) are Electrics per se when they
are as free as possible from wet or
moisture. —

Seperation is produced by
Elective Attraction or the action of Fire.

- Elective Attraction is Absolute or Relative
- single or double. -

Absolute Attraction is when a Body pre=
=sented to two Others, attracts the One but
refuses any Union with the Other.

Relative Election takes place when a
Body presented to two Others attracts
them both but ~~refuses any Union w~~ has a
greater Tendency to One than the Other.
- as an Example as the first we may

take Nitre & Camphor, and adding them to Water we shall find ye Nitre readily dissolved in ye Water, while ye Camphor will remain unchanged. ~~but~~ if in the Room of water we add Ardent Spirits the Camphor will be dissolved & the Nitre left entire. —

we may illustrate Relat: Attraction by ye following Experim:ts. To a portion of Camphor united with Ardent Spirits let water be added, the Spirit having a stronger Attraction to water than to Cam=phor, will imediately let fall ye latter & unite with ye former. A Consequence of Elective Attraction is, yt a Body cannot

be united w:th two Bodies at Once, but
w:th that Only w:ch it Attracts most strongly,
provided likewise y:t y:e Body added a stron=
:ger Attraction w:th Respect to One of the
combined Bodies than those have be=
:tween themselves.

The Effect of Elective Attraction affords
us a very usefull method of Obtaining
Seperations, as in y:e Examples Above or
in y:e following. let a peice of Copper
be added to a Solution of Silver in
Nitrous Acid. y:e Copper having a
stronger Attraction to y:e Acid than y:e
Silver will precipitate it pure to y:e Bottom
and unite itself w:th y:e Acid. upon y:e same

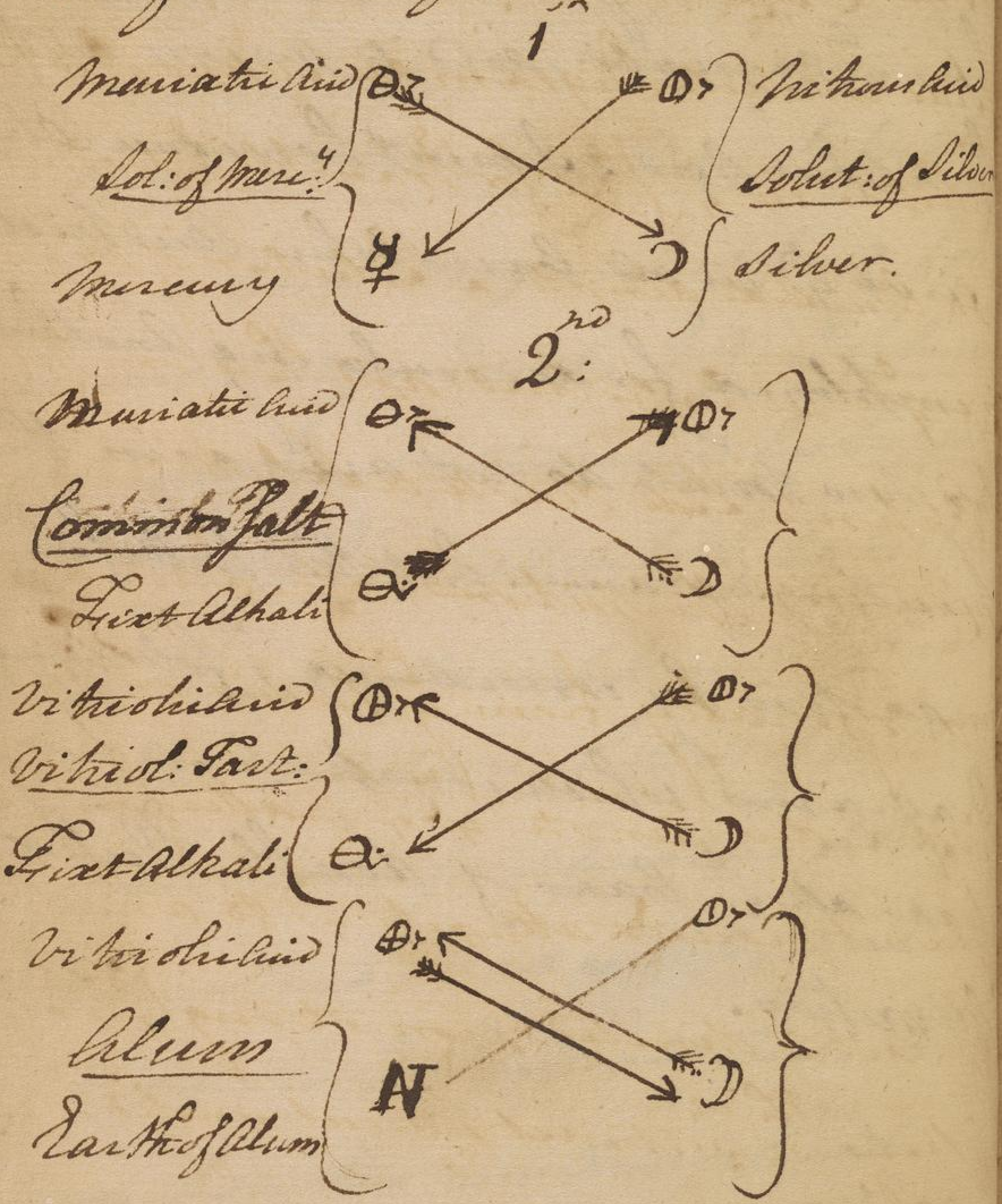
Principles ye Copper may be seperated by ye Addition of Iron. —

Single Elective Attraction takes place when a single Body is employed for decomposing a Mixt. E.g: ye Silver was seperated from Nitrous Acid by Copper

Double Elect: Attraction takes place when One Mixt is employed to seperate Another. as suppose instead of employing Copper alone for seperating Silver from ye Nitrous Acid, I had employed a Solution of Copper in ye Muriatic Acid, there w: have been two new Mixts produced. One by ye Seperation of the Silver from ye Nitrous, and its union w: the ye Muriatic

Acid, the Other by y^e: Seperation of y^e Copper from y^e: Muriatic, and its Union with y^e: Nitrous Acid. I must however Ob=serve y^t: in all Cases when One Mixt is employed for decomposing Another; two new Mixts do not arise as in the preceding Instance: but this will be best understood by considering y^e following Diagrams, which comprehend per=haps all y^e: Cases of double Elective Attraction.

The four Cases of double Elect: Attractions



The Bodies w:^ch stand upon y:^e same side in each Digram are supposed to be united. in y:^e first for Example y^e Bodies on One Side denote a Solution of Mercury in y^e Muriatic Acid, and those on the Opposite Side denote a Solution of Silver in the Nitrous. The Darts drawn diagonally from y^e Bodies on Oppo= site Sides denote y:^e y^e matter from w:^ch y:^e Dart proceeds attracts y:^e to which y^e Dart is directed, more strongly than y^e Body w:^th w:^ch it is at present united.

Thus (Dig: 1:) the ☉r attracts ☽ more strongly than y:^e Mercury w:^th which it

at present combined, and on ye other
hand the ⊖r attracts the ☿ more strongly
than ye ☽ wth wch it is combined.

When ever we add two Mixts whose
parts have ye: same Relations to each
Other as are expressed in ye two first Cases
a double Elective Attraction will always
take place between them, wch may be
thus demonstrated. let ye Attraction
between the ⊖r & ☿ be denoted by a,
that between ye ⊖r & ☽ by b. let ye
new Attraction which takes place upon
a Mixture between ye ⊖r & ☽ be called c
& ye: between ye ⊖r and ☿ be called d. it
is then evident from what has been said
that c is greater than a & d greater ye b.

that is y^e Sum of the two new Attrac:
:tions c + d is greater than y^e Sum
of the Attractions a + b & opposite
thereto; in consequence of w^{ch} an Exchange
of parts will take place between y^e
new Mixt Bodies; w^t has been said
of the first will Obviously apply to
y^e Second Case.

In Case 3^d we cannot always
be certain before the Mixture, whether
a double Elective Attraction will take
place, since we do not know y^e Abso:
:lute powers of Attraction exerted
between Bodies, but Only their Relation
to Other Bodies to prove this let the

Attraction between ⊕r & ⊖r (in Case 3d)
be called a, & the Attraction between
⊕r & ☽ be called b. let also ye two
new Attractions wch will arise from ye
Mixture, be between ~~the~~ the ⊕r & ⊖r &
the ⊕r and ☽ be denoted by c & d. from
ye Position of the Parts we know yt c is
greater than ~~a~~ b, and d also greater
than b. Then is c + d greater than 2b.
But ye Attraction a is indeterminate;
we only know yt it is greater than b,
but are ignorant in wt Ratio it exceeds it
that is Whether a be greater than 2b; this
can be determined by Experiments

place, in most of wh: a is found to be
less than 2b, and consequently a double
Elective Attraction generally takes place
in Case 3d: ——

In Case 4th: we cannot determine be-
-fore Tryal, whether a double Elective
Attraction will take place, & indeed
this is found by Experiments to fail
much oftner than Case 3d: — Let
the Attractions ⊕r and ⊕ Earth of Alum &
⊕r and ☽ be called a and b, and the new
Attraction between ⊕r & ☽ be called c. we
know from the Position of the Darts that c is
greater than a, and also that it is greater

than b; but we can determine by Experiment alone whether a is greater than a + b, which must be the Case before an Elective Attraction can ensue. —

To assist the Chemist in his Studies Dr. Stahl and Sir Isaac Newton began the Construction of Tables of Elective Attractions, together with their Application; but Mr. Geoffroy has published One of a considerable Length, which I ~~shall~~ should here subjoin with an Explanation, had it not been given already so fully by Macquer in his Elements of Chemistry. —

I could wish in this place to give a
Theory of Elective Attractions, but ye Sub:
:ject is so extremely Obscure that we can
only expect to deliver a general view of
it.

Throughout all Nature there seems
to be an Elastic Repellent Fluid, wch is
ye Cause of all ye Phænomena we Observe
in Nature; more particularly of ye various
States of Aggregation in different Bodies.
every Body is surrounded by its own pro:
:per Atmosphere of this Fluid which grows
more dense as it recedes from ye Surface.
This is Analogous to ye Atmosphere of
excited Electricity; which determines Bodies

Once got within its Sphere of Attraction to ye Surface of the Electric Body; it is to be Observed yt Bodies thus in Con=tact wth ye excited Body remain some longer some a Shorter time in Contact wt ye Body Untill they have got an At=mosphere of their own; - then they are repelled till meeting wth some Other ma-ter they discharge their Electric Atmosphere and are again attracted & repelled as before - now let us try if from wt has been said we can form any Conclusions concerning Solution & mixture. I think we can, and am of Opinion yt those Bodies which when brought into

Contact have but one common At=
=mosphere are in a State of Mixture; -
whereas in Solution the particles of
each Ingredient retain their proper At=
=mospheres, and are still capable of ac=
=ting seperately upon Other Bodies ap=
=plied to them. very probably ye presence
of fixed Air has ye power of rendering
Bodies more or less powerful Attachments
or Repellents; and hence it is perhaps
ye bodies having the greatest power of
fixing Air, and by yt means of produ=
=cing a denser Atmosphere, are universally
the greatest Solvents.

In all Cases, as we have already

said concerning Attraction in general the Elective depends upon Fluidity & therefore also upon Solution, Fusion & Exhalation.

I said before that y^e. Seperation of Bodies was produced by two means.

1^st: By Elective Attraction -

2^nd: By the Action of Fire. —

I have finished w^t. I had to say of the former, and shall now proceed to consi=der the latter. The Fire seperates Bodies in consequence of their different Degrees of Fusibility, and acts by Fusion, as for Example. Fat requires a less Degree of Heat for its Fusion than Wax. - Wax a

less Degree of Heat than Lead Lead than Copper Zinc. —

Fire also gives to many solid Bodies y^e State of Fluidity which we call Va=:pour. According as Bodies are more or less apt to fly off in this manner they are more or less Volatile. Whenever by means of Fire we thus raise Bodies in y^e Form of vapour, the Operation is called Exha=:lation. hence it appears y^t all y^e Opera=:tions of Chemistry whether of Combina=:tion or Seperation may be referred to Solution, Fusion and Exhalation.

I shall next proceed to consider these separately. After having premised some

Something concerning ye manner in which Fire produces its Effects.

The Action of Fire removes ye Par=ticles of Bodies further asunder. Wherefore Fire is actually a Repellent power all ye Operations in Chemistry are per=formed by this Repelling power and ye Attracting power. and perhaps we might say that all ye Operations of Nature as well as of Chemistry are performed by these Agents. we do not know any Body in its utmost State of Condensation, nor do we know any Body that is impervious to Fire. ye Repelling Elastic Fluid or Ether

of Newton is universally diffused thro=
out all nature. and constantly acting as
a Repellent power.

The Attractive and repelling powers
are constantly acting in Opposition to
each Other, and yet perhaps depend
upon ye very same Other acting in
different Circumstances. & it will not
be difficult to admit this if Our Postu=
lation be granted viz: that Inert matter
in a certain Contiguity of its Parts
has a power to deminish ye repelling
power of ye intervening Other betwixt
its Particles. this admitted ye Attractive

power ~~may be~~ entirely ye Effect of Repulsion

When two Bodies are in such a close Contiguity as to diminish ye Repelling power of ye intervening Ether, if any Power is applied ~~to~~ render ye Ether again active, the Bodies will also be again seperated by the ye repelling power. thus Fire acts on Solid Bodies seperating by its repelling power their Parts, first bring them to a State of Fusion, & afterwards if more encreased dissipating them in ye Form of Vapour. if all ye different properties of Bodies depend upon their different States of Aggregation, their

Differences again depend upon Ether:
kind Ether. and Inert Matter are hence Sup=
=posed to be ye Only Matters in Nature,
and ye latter of One kind Only.

This Theory is not new. You may
collect it from Newton's own works,
but more particularly from Dr Bryan
Robinson's Treatise upon ye Ether of
Sir Isaac Newton. it is ye most plau=
=sable Scheme of Chemical Philosophy &
will at least check ye false Theories of
ye Corpuscularians. but in an Attempt=
of this kind ye Difficulty is to find the
Cause of Elective Attraction, or Why

Ether does not admit of an equal Union w:th all Bodies. having said so much by way of Introduction, I now proceed to a seperate and more particular Consi=-deration of Solution, Fusion & Exhalation

Solution

When a solid Body immersed in a Fluid is diffused equably and uniformly thro every Portion of y:e Fluid, so as to remain w:th it in a fluid Form y:e Operation is called Solution. ——

The solid Body is called y:e Solvend & the Fluid in which it is dissolved is called y:e Solvent or Menstruum. the Term Menstruum took its Rise from this Circum:

stance, that y^e Ancient Chemists used to allow a Month for y^e Solution of a Body imagining y^t this portion of Time had a peculiar Effect upon y^e Solution. I would use y^e Term Solution in a still more extensive Sense, and apply it to y^e mixture of Fluids w^th Each Other, for the Term is equally proper if y^e Original Compages or Texture of y^e Fluids be broken down, and indeed we find it is as common to Speak of y^e Solution of Essential Oils in Ardent Spirits as of Camphor. But in y^e Case of Fluids it may be often a difficult matter to determine w^ch is y^e Solvend, & w^ch is the

Menstruum. the best way of distin=
=guishing them is this: When ye: Quan=
=tities of ye: Fluid are unequal. let ye Large
be called ye: Menstruum, & ye: Smaller
the Solvend. When ye: Quantities are equa
we cannot always make a Distinction
Chemical Solution must be distin=
=guished on ye: One hand from Diffusio
commonly called Mechanical Solution
and on ye: Other from proper Mixture. -
When Bodies Specifically heavier than
a Fluid are immersed therein. they will de=
=scend to ye Bottom but, ye times of their
Descent will be reciprocally proportiona
to their Specific Gravities. E g: if we drop
a Ball of Gold, and another of ~~wa~~ Glass. the

Gold having ye greatest Specific Gravity will descend in the least time. But a Body of any Specific Gravity may be suspended in a Fluid by Division; for if a Body be divi:ded into a number of parts, ye Quantity of Matter of Specific Gravity of each of those parts will decrease in a greater Ratio than their Magnitudes or Surfaces. thus if a solid square Body contain 16 equal parts, or Cubic Feet, the superficial Con:tents of each of those parts will be one square Foot, and their solid Contents equal to 1 Cubic Foot. From this it is most evident that ye Surfaces of these parts taken separately are exceded by ye Surface of ye mass before Division as 4:1, whereas ye

solid Contents decrease in y^e^ greate
-tio of 16 to 1. the Suspension of Gol
water when it is broken down or divid
into parts sufficiently minute, depen
upon y^e^ foregoing principle. this is w
I call Diffusion, and w^ch^ Others call Me
-chanical Solution, by way of Distin
from Chemical, which is y^e^ intima
& minute Union between y^e^ parts of
Solvend and Menstruum which we m
illustrate to you by y^e^ following Fa
If One Grain of common Salt be di
-solved in several Gallons of Water, th
least portion of this Solution w^ch^ w
can examine added to a Solution o
Silver in nitrous Acid will discover a

much y^e: Appearance and Effects of the Salt, as if the whole Grain had been dissol=:ved in a few Drachms of Water. it is however very difficult sometimes to dis=:tinguish between Mech^l: & Chemical Solution. the former will sometimes pass thro' a Filtre without Sediment, w^ch: has generally been tho't a distinguish=:ing mark between them. the most obvious Distinctions are, y^e: Chemical Solutions are transparent, Whereas y^e: mechanical for y^e: most part have a turbid Appearance, or that y^e former are permanent, the latter only tempo=:rary, or that y^e: former takes place

only by bringing y^e Bodies into a proper State of Contiguity. Whereas y^e latter require Agitation, yet perhaps none of these means of judging are entirely unexceptionable. —

Again. Chemical Solution strictly Speaking may be distinguished from w^t we call proper Mixture by se=veral Circumstances. in Solution there happens no Other Change of Properties y^n the Reduction of the Solvend to a fluid Form, or rather the Division of it into its minute integrant parts, as happens in the Salt and water. In proper Mixture the Bodies do not retain the properties w^h they had before such Mixture, but the

Result is w:^ch^ we call a _tertium quid_, or a third Substance differing from those Ingredients w:^ch^ compose it, & possessing new Properties. an Example of this we have in the production of a neutral from an Acid and Alkaline Salt. there may be however some Cases wherein it will be difficult to distinguish them by this mark. in Solution there is no Generation of Heat, but I think that no Mixture ever takes place without a Generation of Heat. Another Distinction may be that two Bodies only can be united at y:^e^ same time (w:^ch^ was Observed when we mentioned Elective Attraction) whereas in Solution more than one Body.

may be united w.th a fluid at y.^{e} same time. I am not certain of y.^{e} univer-sality of this Remark, but in general it seems to hold true. —

The power w.^{ch} Menstrua have of dissolving their Solvends is limited as well in Solution as proper mixture. thus a Quantity of water will take up half its weight of Glauber's Salt, $\frac{1}{6}$ of Nitre, and $\frac{1}{3}$ of common Salt. but whatever is added of y.^{e} Above mention'd Salts to water, more than y.^{e} proportion specified this additional Quantity will fall unchanged to y.^{e} Bottom. When a Fluid therefore has dissolved y.^{e} greatest Quantity of a Solvend possible, that flu

is said to be saturated. in Solution a Saturation is generally effected by the Solvend. with Regard to proper Mixture Saturation takes place when ye Bodies are combined in such proportion as to form a perfect Neutral, but is not con=fined to the Solvend, but may be effec=ted by ye Solvend or Menstruum alter=nately. E:G: if to Syrrup of Violets be added an Alkali the Colour is chan=ged to a green; if to this Compound a Quantity of Acid be added exactly sufficient to saturate the Alkali or in other words to form a neutral, ye Syrrup will immediately recover its blue Colour,

but if Again you add to this satu-
=rated Mixture a Quantity of Acid or
Alkali the Syrup will be changed al-
=ternately to a red or green as the One
or Other predominates. —

The Vessels commonly, & most
properly employed in Solution are
Matrasses and Bolt=heads. When a
Matrass is closed by another smaller
& inverted, and joined to it, it is called
a Circulatory Apparatus or Pelican. ye
former of these terms is applied, because ye
vapours arising from ye lower vessel are
condensed in the upper and return
Again to the lower by a continued

Circulation. the best Substance for making these vessels is Glass, because it is least liable to be corroded by any Menstruum. and at ye same time wth proper management will sustain a very great Degree of Heat. this Quality is much encreased by a Spherical Figure, and uniform thickness of ye Glass.—

The Operation of Solution may be expeded by several means 1st by the Division of the Solvend. it is evident that ye Menstruum can act at ye same Instant of time upon those parts of the Solvend Only wch are exposed to it, or in other words on its Surface. now if

by any means ye number of particles
immediately exposed to ye menstruum in
any given Quantity of the Solvend, be
encreased, or wch is ye same, ye Surface
of the Solvend be encreased, it will be
evident that ye time wch ye menstruum
will require to dissolve this given Quan-
-tity of the Solvend. must be propor-
-onably lessened. for ye Menstruum w
act as forcibly upon ye greater as the
smaller Surface, and consequently in
a given time produce a greater Ef-
-fect. That this Increase of Surface
of the parts exposed may be effected by
Division will be obvious from the
principles mentioned on ye Subject
Mechanical Solution. 2ndly

2ndly By the Agitation of the containing Vessel. tho' chemical Solution is per=:formed merely by adding the Bodies to each other; yet we may expedite it by Agitation, because by this means a grea=:ter portion of the Menstruum is app=:ly'd to ye Solvend and vice versa at ye same time. E.G. Spt: of Wine poured gently upon Water will swim on ye Surface without any Appearance of Union. But one Shake of ye Vessel will so in=:timately diffuse them together, they they will remain united for Years. if ℥i of Salt be added to a Gallon of Water. it will not dissolve in as

considerable time, but if y^e be fully agitated it will dissolve in a short time Mon:^r Lagnard has invented a Machine for promoting Solution. I suspect y^e advantages arising from it will not be so great as he imagines. Tho' one advantage will be y^t we may dissolve Bodies in y^e Cold, which is a Matter of great Importance, as Heat changes considerably y^e Properties of many Bo=dies. —

3^rdly: By the Application of Fire. When I was treating of Saturation I Observed y^t any particular Menstruum would only saturate a certain pro=portion of the Solvend, & y^t varying in

different Bodies. I ought however to have Observed y^t: y^e Temperature of y^e Menstruum Sh^d: be precisely y^e: same in every Experim^t: for y^e: power of a Menstruum encreases very much by y^e: Application of Heat, so y^e: Water w^ch: in y^e Ordinary State of the Atmosphere dissolves only $\frac{1}{6}$ of Nitre will when boiling dissolve a Quantity exceeding y^e: greater. The Heat may also act as a Repellent in Separating y^e parts of y^e: Solvend, but of this more hereafter.

with Regard to y^e: Application of Heat it may be done two ways, either in close or open Vessels. in y^e: latter Practise for Solution the Application of Heat is much limited, for all Fluids in a certain

Degree of Heat arrive at w:ch is called the boiling point, after w:ch they cannot pos=sibly be rendered hotter; but if more Heat be applied they fly of in vapour: thus Red^d. Spirits boil at 176° of Farenh: Ther=mometer. water at 212°: but Oil w:ch suffers some Resolution by boiling requires a much greater Heat. the boiling point of Fluids varies w:th the pressure of the Atmosphere. Baron Montesquieu who lived near the Pyrenees tried y^e Experiment at various ~~Heat~~ Heigths on those mountains, & found y^e as he ascended to diff:^t Heigths where y^e pressure of y^e Atmosphere was

consequently less, ye Heat necessary to boil
water became much less than 212°, & e
contra ye: ye: boiling point encreased as
he descended till at ye: Bottom it arrived
again at 212°.—

About 80 Years ago was contrived an
Instrument called Papin's Digestor, wch:
is a strong cylindrical Copper Vessel, wth:
a Cover fitted so accurately wth: a Screw and
Lever as entirely to exclude ye: external
Air. The Spring of ye Air in this Vessel be-
ing encreased by Heat may be made to
act wth: a pressure extremely great, wch: will
consequently enable ye: contained Fluid
to bear a much greater degree of Heat,
than it would have done in ye Open Air;

the Spring of ye Air may be so encreas'd
as to ~~make~~ break ye: strongest Vess
— to prevent wch: there is generally a Ho
at ye Top covered wth: a Valve. this Va
must be compressed by such a Weigh
as will give way to ye Force of ye Elastic
Air, before the Vessel is burst. Papin's Di
are usually made of Copper, or some
Other Metallic Body, but these are
inconvenient as they are apt to bec
=roded by most saline Substances. this
Inconvenience has luckily occasion'd ye
Invention of the Glass Digestor. the He
wch: this bears is not so great as in Papin
yet it is sufficient for most purposes. the

boiling point of water is perhaps ye greatest Heat to wch we can expose it wth Safety; but even this enables us to give Ardent Spirits wch in Open Vessels waporates at 176°: the Heat of boiling water wch as we mentioned before is 212°. a Thermometer might be inserted into this Digestor for regulating ye Degree of Heat. it is supposed ye Solutions made in the Digestor differ from those made in Open Air, as ye former have generally a turbid Appearance; I am sure it diminishes ye Elegance of the preparation; whether it improves its active Qualities I shall not here determine.

Solution is promoted

4thly: By the Application of Air. Ancient Philosophers have supposed yt water was the primum Liquidum, or ye primary Cause of the Liquidity of all Bodies. Later Speculations & Experiments have made rendered it extremely probable yt Air is a principal Agent in giving Bodies Liquidity. if Water saturated w: Nitre be put under a Receiver when the Air is exausted a portion of ye Nitre will be precipitated. When Acids act upon Alkalies or Metallic Substances a great Quantity of fixt Air is ex-
=tricated

it is highly necessary to ye Solution, that this Air be absorbed by the external Air, wh: readily takes place by an Elective Attrac-:tion between ye first, and ye: common Air, and between ye Solvend and Men:struum. in Consequence of this the progress of the Solution will be much impeded by excluding ye: common Atmosphere. Eg: Copper put into Vol. Alkali if kept from the external Air will not be much affected by it. but if free access of the common Air be allow:ed the Alkali will quickly dissolve it. If after the Solution is compleate it be enclosed in a vial from wh: ye Air is

entirely excluded the Copper in proceſs of time will be precipitated from ye body Alkali. Besides these, very numerous Facts might be adduced to show how extremely neceſsary the Air is to ye progreſs of Solution. One Other I shall mention wch occurs in our Kitchens it is when any Corrosive Body is kept in Copper veſsels for a long time ye part of the veſsel Only is acted upon, where there is Communication between ye Air - the Fluid contained - & ye veſsel, wit round the Edges of the Fluid.

In the Conduct of Solution it is proper to avoid Effervescence & Diſsipation, of

have already Observed that some Bodies are extremely volatile, so as to be dissipa-
-ted wth a very small Degree of Heat. to avoid this. it is necessary to use close vessels. and apply very little Heat. —

Effervescence is that intestine Moti-
-on wch arises upon the mixture of some Bodies, from a sudden Extrication of their fixed Air, and the Reduction of it to an elastic State. that Effervescence depends upon a Seperation of Air, is evident from this Experiment. tie a Blad-
-der loosely over the neck of a vial contai-
-ning Iron Filings, then add a Quantity of the Nitrous Acid thro' an Aperture in

the Side of the vial, and we shall Observe (if the Aperture be closed) y: the Bladder will be distended with Air as the Efferv=escence goes on, till it burst if a vent is not given. — now this Effervescence is to be either avoided or Moderated upon se=veral Accounts, 1.st It is in some Cases so violent as to rush Over the vessels if Open, and burst them if closed. 2.nd The vapours arising from many Bodies are so deleterious as Oftentimes to bring on instant Death to Animals who breath them. 3.rdly these vapours are some=times very inflamable, so that if they come in Contact w:th burning Bodies they

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immediately take Flame, and explode w:
great danger to the Operator, if they are
very copious. we may see an Example
of these inflamable vapours by apply=
=ing a Flame to the vapour of vitriolic
Liquid, and Filings of Iron during their Ef=
=fervescence.

I shall now go on to mention the
best Means of avoiding Effervescence.
1st: By adding the Solvend in small Quan=
=tities; for the Degree of Effervescence is
generally proportional to ye Quantity of
the Bodies added. we must however Ob=
=serve to let ye Effervescence of ye first
Quantity cease before we add a second.

an Exception to this general Rule oc=
=curs in the Mixture of Nitrous Acid &
Mercury in wh: Case the Solvend is all
to be added at Once. this is readily ac
=counted for, because Mercury when ap
=plied to an Acid in the cold does not
afford much Effervescence, but as ye
Heat in which the Mixture is made
encreases, the Violence also of the Effer=
=vescence will encrease in a great pro:
=portion; now if the Mercury be applied
gradatim, in the common way the Heat
excited by the first Addition, would encrease
the Effervescence of the Second, & this of ye
third &c. yet in the Case of Mercury we

might add it gradatim provided the
Heat excited by the first, subsided before
second Addition was made. This practise
however would be very tedious.
Another Method is by performing ye Opera=
=tion in close vessels excluding the external
Air, which as it promotes the Solution of Bo=
=dies will consequently encrease their Ef=
=fervescence; but this Operation is attended
with great Hazard of bursting the vessels.
in this practise the circulatory Appara=
=tus which gives Room for the Ascent of
vapours, or a Matrass with a loose Stopper
are ye safest and most convenient vessels.
Mr. Geofroy however has invented a

Method of avoiding the Effervescence in
these, by interposing a Quantity of Oil
between the external Air and ye Menstru[um]
— Thus you see a Quantity of Oil floating
upon the Nitrous Acid, if again we take
Bits of Iron previously dipped in Alkohol
that ye Oil may not adhere to them, and
drop them into the Acid an Effervescence
will ensue, but not near so violent as
if they had been mixed without the Inter-
-position of the Oil i e in the Open Air.
in Some Solutions also the Effervescence
is different as we add ye Menstruum to
the Solvend, or the Solvend to ye Menstruum,
thus in a Solution of Alkohol in

Nitrous Acid. the Effervescence is much greater when we add y^e Alkohol to the Acid, than when we add the Acid to the Alkohol. this Phanomenon is explained by the Action of the Air, for in the latter case the Acid being heavier than the Alkohol sinks to the Bottom, whereas in the former the Alkohol swims at the Top, and is more exposed to the Air.

We must be careful to distinguish between the intestine Motion named Effervescence, and y^e of Ebullition and Fermentation.

Ebullition is properly applied to that Motion Only which is excited in Fluids

after they arrive at ye boiling point.
That Motion Only is called Fermentation
wh: has an assimilating power, i.e. when
the properties of one of the Bodies that
is added is rendered the same as the
Other. we have an Instance of this
in Leaven; a small Quantity of which
added to a larger Quantity of Dough
leavens the whole. or assimilates it to
its own nature. —

Solution acording to certain
Differences in the practice is named Mace-
-ration, Infusion, Decoction, Digestion,
Circulation, Deliquescence or Amalgamat:n
1:st Maceration. Maceration & Infusion

have been promiscuously employed to signify the same thing, but w:th ye: greatest Impropriety, for Maceration properly is when we employ a Heat less than the boiling point. —

2:nd Infusion is when a Fluid is poured on at the boiling Heat, and then suffered to cool. —

3:rd Decoction is the continued Application of the boiling Heat.

4:th Digestion is Heat continually applied to a Fluid without boiling. if the Heat is less than the boiling point it may be performed in Open Vessels, if greater in close vessels, to prevent boiling, and in

this Case it is most properly called *Diges-tion*.

5.th *Circulation* is when the vapours aris: from one vessel are condensed by another & ~~and~~ by some Communication return to y:e first in a liquid Form.

6.th *Delaquescence*. the Air is always re-plete with watery Exhalations, w:ch some Bodies are much disposed to Attract & thence run into a fluid State. When this process takes place it is called *De-laquescence*. the process of making Ol: Myrrh: p Deliquium comes properly un-der this Head. —

7.th *Amalgamation*. this Term is applied

only to the Solution of Metals in Mercury.

Having now considered y^e Means of combining Solvends wth: their Menstruums. let us now take notice of the Means by w^{ch}: difsolved Bodies may be seperated from their Menstruums. This is done by Precipita:tion – Chrystalization & Evaporation.

1st Precipitation depends upon Elective Attraction so y^t it is a Species of Solution. When to two Bodies united by Elective Attraction a third be added w^{ch}: unites wth: One, & consequently seperates the Other, y^e Procefs is called Precipitation, & y^e Body added is called the Precipitant.

There are only four different ways of Precipitation. —

1: Of the dissolved Body alone

2nd: Of the dissolved Body and ye: Precipitant

3d: Of the Menstruum alone.

4: Of the Menstruum wth ye Precipitant.

Example of the 1st Case. — If to a Solution of Silver in Nitrous Acid be added Filings or Plates of Copper, the Silver will be pre=cipitated to ye Bottom in ye Form of White powder, as fast as ye: Copper dissolves because the Acid has a stronger Elective Attraction to ye Copper than to ye Silver.

Examp: Case 2nd: If to a Solution of Silver as before we add ye: Muriatic Acid it will attract ye: Silver from the Nitrous, and

uniting w:^th^ it falls to the Bottom in a solid Form, for the Muriatic Acid does not dissolve Silver, but only corrodes it.

Examp: of Case 3^d^: If to a Solution of Gold in Aqua Regia we add y^e^ Vitriolic Ether, the Gold will be attracted by, & suspended by the Ether while its former Menstru:um falls to the Bottom.

Example of Case 4^th^: If to a Solution of Camphor in Alkohol we add common water, the Alkohol and water will unite and fall to the Bottom, while y^e^ Camphor will swim on their Surface.

By the third Experim:^t^ we may

determine the purity of Gold wth: great[accu]
=racy, for if any Copper be mixed wth: it
Aqua Regia will keep the Copper [dis]
=solved, and by that means appea[r]
more or less of a blue Colour according
to y^{e} Quantity of Alloy.

In the two first of the foregoing Cases
the falling Body is called y^{e}: Precipitate
the Magistery or Calx.

There may be Instances w^{ch}: cannot wth
strict propriety be referred to any of y^{e}
former Cases. E.g: when Silver is added
to a Solution of Gold in Aqua Regia, it
attracts, and unites with the muriatic

cid of the Aqua Regia, in Consequence of wch the Gold, and ye remaining part of the Aqua Regia viz: the nitrous Acid, will continue seperate and unchanged.

If Water be added to a Solution of Me=:tallic Substances in Acids, a Precipitn: of the M: S: ensues. Whether ye Acid has a stronger Attraction to ye water than to ye M: S: or whether ye Qualities of the Acid wth Relation to ye M: S: be changed by Dilution, I shall not here take upon me to determine.

Before we leave this Subject of Precipitation, I shall add some general Directions for ye Practise of it.

When Precipitants are used it is necessary in general to dilute the Solution w: Wa-ter & when Precipitations are effected by Wa- ter alone it must be added in large Pro-portions. by this Dilution we cause a perfect Separation. there are some Excep-tions to this Rule perhaps that are not taken notice of by Chemists. E.g. if any Substance precipitates in particles of great minuteness, these may be me-chanically diffused for a long time, thro' a large Quantity of Solution, & ye Operation may be rendered more tedious, if not impracticable. in Precipitation Effervescence is to be avoided for ye same

Reasons. and by y^e same means we
mentiond when treating upon y^e Subject.
we must not add a greater Quanti=
=ty of the Precipitant than is just Suf=
=ficient for our Purpose, for many Sub=
=stances if added in a greater Quantity
than is requisite for y^e Precipitation of y^e
Solvend will occasion y^e Menstruum to
redissolve the Precipitant. E.g. If to a Solu=
=tion of Silver in Nitrous Acid diluted, be
added the volatile Alkali gradatim to
avoid Effervescence a Precipitation will
ensue. we must continue to add
gradatim so long as any Milkiness

appears. but if After this the Addition be
continued to a certain Degree, the precipi-
-tated powder will be again taken up
and the Whole become One transpar[ent]
Fluid. —

Edulcoration. When a Precipitant has
a part of the Acid which had formerly
dissolved it, still adhering to it, the washing
of that with water is called Edulcoration.

Corrosion. When a Metallic Substance
can be combined with an Acid in a dry
Form only the Combination is called
Corrosion.

In most of the Practices of Solution
there is Occasion for Colature & Filtration
— the first of these Terms is applied to

straining thro coarser Filtres, as the Hair=Seive=woollen Cloaths &c. the lat=ter is chiefly used for ye finer Filtres as Paper &c. the most convenient kind for this purpose is Blossom=paper, the Filtres of which are longer than of common Paper. —

In Opposition to Solution is Coagu=lation, or the Practise of reducing Fluids to a solid Form. —

The Action of Fire has ye Effect of co=agulating Animal Fluids, as we see in the Whites of Eggs, and many Other Cases.

Sometimes dry Bodies ~~[illegible]~~ coagu=late

Fluids by entangling them in their pores and preventing them from moving freely. E.g: If to an English pint of common Water, be added a tea-spoon-full of Salop (w^ch is a Root brought to us from the Levant) in fine powder, the Whole will shortly become a thick Gelly. Most Instances of Coagulation are only the Effect of Precipitation, as appears from adding Alkohol to a Solution of Glauber's Salt in Water. ~~even~~ But in this Case it only happens in Consequence of Agitation, for if the Alkohol be ad=ded gradatim, or the Solution suff:

to remain at rest for sometime, even after it has assumed a solid Form, the Alkohol will attract the water to the top, and the Salt will be precipitated to the Bottom. —

Of Fusion. —

Before I speak particularly of Fusion, or the Reduction of solid Bodies to a fluid Form by the Action of Fire, I shall say something concerning ye Theory of Fluidity in general. —

The Ancient Philosophers Observing yt all Fluids as Oils, Acids, Ard: Spirits and even Mercury received Water into their Composition, concluded that

Water was y^e^ primumLiquidum or universal principle of Liquidity. this Reasoning however is easily overthrown by considering that water is not tenacious of its Fluidity and y^t^ many Solid Bodies mixed w^th^ water encrease its power of retaining Fluidity. —

The Corpuscularians say y^t^ the Flui=dity of Water depends upon y^e^ Sperical Figure of its Particles, w^ch^ slide easily over each Other, and yeild to the least pressure. this Opinion is false & im=probable, for these Sperical Atoms were never proved to exist, & even gran=ting the Existence of such Particles, it is

to me Altogether inconceivable how by the Diminution of One or two Degrees of Heat in the Thermometer, these Particles can be so entirely deprived of their Figure as to form a Mass, hard and Solid, or how by restoring ~~this~~ the Heat they can regain their Spherical Figure and instantly become fluid.

We know no Body in nature that will not assume a fluid Form under a certain Degree of Heat, nor is there any Body in nature which will not under a certain Degree of Cold assume a solid Form, however Often we meet with it in a fluid State. hence it

appears y:^t Fluidity is not essential to any Body in particular. I shall therefore when I mention Fluidity understand by it a certain Relation of Bodies to Fire, — which seems to be the sole Cause of Fluidity. — Solidity, Fluidity and Vapour in Bodies of Bodies seem all to depend upon the State of Elastic Æther upon their Surface, & within their Pores. when the Repulsion of y:^e external Æther prevails over that of the internal, the Body is preserved in a State of Solidity. when by the action of Fire the Elasticity of the internal Æther is much encreased

as exactly to counterballance ye external: the Body is reduced to a State of Fusion. but if the Fire be still further encrea:sed, the internal Æther acquires a still stronger repulsive power, and becomes superior to the external, then ye Body flies off in vapour, each particle being as it were surrounded, by a repellent power of its own.

Fusion combines Bodies by wh: has been called dry Solution, & separates by Elective Attraction or the Action of Fire in different Degrees on different Bodies.

When an Elective Attraction takes place under Fusion the Operation is

named a Precipitation by Fusion, or Precipitatio fusoria, and in the Case of Metallic Substances the parts sepa-rated are termed Scoriæ or Regulus. y word Scoriæ was formerly applied to y gross part Only wch is thrown Out in the Precipitation of Antimony; but it is used to signify all ye vitrified friable Matter that is thrown of by Metallic Bodies in a great Degree of Heat. –

The pure Mettaline part of Antimony concretes somewhat in ye Form of a Crown, & hence it received ye name of Regulus or Little King. This Term

however is now applied to y^e Mettalic
part of all Substances. —

As an Example of this kind of Separation
viz: by Elective Attraction, let us exa=
=m in the Process of purifying crude
Antimony. this Substance is compos'd
of Sulphur, and a pure Metalline
part called Regulus. it is required to
seperate the Sulphur from y^e Regulus.
to effect this we must find a Substance
which has a stronger Elective Attraction
to Sulphur than the Reg: of Antimony.
among such Substances we shall
find Iron or Tin. let us therefore put
thin plates of Iron into a Crucible in

a Melting Furnace wth. the Addition of
little fixt Alkali to promote ye. Fusion
When the Crucible is red hot, put in y
Antimony. let the Whole be fused tog
=ther. After this removing ye. Crucible fro
ye Fire, suffering it to cool, we shall find
the Regulus at the Bottom, and the
Sulphur united wth. the Iron in Scoriæ
at the Top. —

As an Example of the second kind of
Seperation viz: by the Action of Fire,
we apply a mixed Mass of Lead & Copper
to a Heat just sufficient to melt the Lead.
in Consequence of this the Lead will all be
fused, & run Out while the Copper will

remain unchanged.

The Fusion of Bodies may be consi=
=dered as of two kinds; the One where ye:
Body melted suffers no Change, but ye:
by the Action of Fire, from solid it
becomes fluid, and upon removing ye:
Fire concretes into ye: same Form as
before. The Other Case is, where ye Body
melted suffers such a Change, that upon
cooling it does not concrete into the
same Form as before. of this ye most
noted Instance is Vitrification. —

The Fire separates Bodies under Fusi=
=on by acting upon ye: common Fusi=
=bility or by acting upon yr: Vitrescency.

upon the first depends Eliquation and Congelation, upon the second depend Scorification and Cupellation.

When solid Bodies varying in their Fusibility are combined, & we seperate them by that means, as in the last Ex=ample of Lead and Copper, ye Operation is named Eliquation.

The Seperation of fluid Bodies by carrying the heat below ye freezing point or in other words by encreasing ye Cold, is called Congealation, and is just the Reverse of the former, tho' both depend upon the same Principle. Viz: ye different Degrees of heat, and the different Fusibilities

of Bodies. E.g: If a Degree of Heat below 30° in Farenh:t be applied to a Mixture of Alkohol and water, the water will soon be converted into Ice, while ye Alkohol on acc.t of its greater Fusibility will remain fluid ~~~~ and pure.

If Lead be continued on ye Fire after Fusion, a thin pellicle will ap=pear wch will break and retire to ye Edge; this will be succeeded by a second &c — till the whole Mass be converted into thin Pellicles or Scoriæ. This Ope=ration is called Scorification, & is much expeded by a continual Blast of Air upon the Metal.

If these Scoriæ be exposed to a greater Degree of Heat, they turn of a dusky brown Colour, and after y^e they become Red=Lead or Minium. if the Minium is fu=sed it will concrete into vitrified Mass. this latter Process is called Cu=pellation. the Minium when in Fusion is of so subtile a Nature, that it pervades y^e Pores of almost any Vessel, hence it has been a Desidera=tum among Chemists to invent a Substance y^t would contain it.

Lead is not only of itself readily vitrified, but it also disposes various

other Bodies to Vitrescency, as Earths, and all Metallic Bodies except Gold & Silver. hence if these be fused w:th Lead it separates in the form of Scoria, accom-panied w:th all the heterogeneous matter of the Gold and Silver. —

When a Metallic Substance has been deprived of its metallic Form, & is by certain means under Fusion brought back to it again y:e Operation is named Reduction. — this is effected by letting the changed Substance come in Contact w:th Vegitable Fewel in Cases of Vitrification. E.g. if the minium of Lead be fused w:th a Quan-tity

of Charcoal, it will recover its for-
-mer Metalline Appearance. —

The vessels most commonmonly emplo-
-ed in Fusion are Crucibles. these
were made formerly in Hesse of a
particular kind of Earth, and were
named German Crucibles. but they
are greatly inferior in Strength &
Fixity to those made now in Britain
of black-Lead. — it is necessary in
many Operations to prevent the
Contact of burning Fuel. this is
conveniently done by stopping our

Crucible w:th a smaller inverted.

In Scorification &c are employed Tests. Cupels, and Muffles. the Test or Cupel, w:ch is smaller, and more used at present, is put into a Muffle to prevent y:e Contact of the Fire w:ch is a necessary Caution in these Operations. —

Of Exhalation.

When the parts of Bodies are separated w:ch at present cohere, and fly off in the Air, such Bodies are then said to be vola-tilized, or exhaled, and y:e Operation is named Exhalation. —

The principal Causes of this are as

follow; either when the parts being Specifically lighter than Air are boyed up therein, or 2^nd. the Air acts upon Bodies as a Menstruum, & by that means carries them off. or 3^rdly. when the parts are driven off by ye Force of Fire. the Distinction between the first and last is extreemly nice; for the Fire acts as well by rarefying Bo=dies as by rendering them more Elastic. —

Exhalation is various, as it is prac=tised for Obtaining the — Fixed parts

— — Fixed parts
of Fluids by Evaporation
of Solids by Ustulation & Calcination
the Volatile Parts
in a fluid Form by Distillation
in a solid Form by Sublimation.

Of a like Nature wth these two last, but some-
-what different in the Manner of Operating
are Cementation and Inflamation.

When in seperating the volatile parts
of Bodies we apply them at the same time
to other purposes, the Operation is called
Cementation, from a Resemblance it
is thought to have to the work of Masons.
E.G. If I have a Compound of Gold & Silver,
I can by the same Operation Obtain a

Solution of the Silver and a Seperation of it from the Gold; lay a Stratum of green Vitriol and Nitre upon the Bottom of your Vessel, and over this a plate of y^e mixed Metal, -let this be repeated till the Vessel is full, then lute it, and apply it to y^e Fire. in this Operation the Acid of the Vitriol unites w^th the Alkali of the Nitre; - the Acid of the Nitre ascending in Fumes unites with every portion of the Silver of the mixed mass in the form of Corrosion, w^ch may there-fore be swept quite clean from the Gold.

When Nitre is applied to burning Fuell, its Acid is exhaled, and y^e Alkali remains behind. This is an Instance of Inflamation or the Application of Bodies imediately to

the Fire. Under this is comprehended wh: has been called the Sublimation of Geber.

I now proceed to consider ye: Operations belonging more particularly to Exhalation.

Evaporation is practised on Fluids chiefly for Obtaining the fixt parts, while the volatile are suffered to fly off. & according to certain Circumstances of the Subject is named Inspissation or Extraction. —

When a Fluid contains a number of Heterogeneous Bodies more fixt than itself, if we evaporate this considerably, ye: heterogeneous parts will render ye: remai-ning Fluid thicker, whence ye: Operation has been named Inspissation. —

When we practise on Animal & vegitable Substances in Order to Obtain their virtues by Solution we must use a large quan=tity of the Menstruum. this however often renders the Preparation too bulky, so y.^t we must reduce it by Evaporation, and this Operation has Obtained y.^e name of Extraction. —

When Bodies suspended in a Fluid by Solution are made to subside, they com=monly assume the Form of Crystals: & hence the Term Crystalization. this is almost universally applicable to Saline Bodies only; I do not say wholly, be=cause, so far as we know it may be

practised upon some Other Bodies. Na:
:ture indeed promotes it in all Bodies.

2 Crystalization depends sometimes
upon diminishing the Heat. for if boiling
water, saturated with Nitre, be set to cool,
we may Observe the Nitre crystalizing
as the Heat decreases. but as it more
generally depends upon diminishing yᵉ
Quantity of the Menstruum by Evaporatⁿ:
it belongs properly to this Head. —

3ᵈ Evaporation is carried on by yᵉ Action
of Air or Fire, or by the joint action of both.
the Air serves not only to buoy up the parts
seperated by Fire, but acts also upon many
Bodies as a Menstruum, and yᵉ: like other

Menstruums in proportion to its Heat as
I shall endeavour to prove hereafter. —

It may be useful now to add some
Rules for the practise of Evaporation. in
Evaporation we are liable to many Incon-
=veniences from an Excess of Heat, for the
parts of some Bodies differ so little in their
Fixity, that without great Exactness the
Whole will be dissipated; or when y^e Exhalation
is performed too rapidly, the light fixed
parts may be carried off by the volatile;
or they may be entirely changed and
contract an Empireuma, to which all
Animal and Vegitable Substances are

Obnoxious from too great Heat. to Ob:
:viate these Inconveniences & to lessen ye:
Labour of the Operation, some Medium
is interposed between the Subject & the
Fire, wch: will bear a slow regular, and
determined Heat only, for this purpose
Fluids wch: receive no Heat after the boi:
:ling point are most proper. in different
Cases we ought to employ Fluids of
different Fixities; for some Substances
undergo a considerable Change of Qualities,
even from the Heat of boiling water.

The Water should be continually stirred
till it boils, and then ye: Ebullient

motion will answer the purpose, Otherwise the more solid parts lying in Contact with the Bottom of the vessel, may become Em-
=pyreumatic.

The Surface of the Fluid Ought to be as much encreased as possible, for Evapora-
=tion is found to go under a given Degree of Heat in proportion to ye Quantity of ye Liquor exposed to the Air. —

The late ingenious Dr. Hales invented a Method of throwing fresh Air continually upon the Evaporating Liquor, thereby very much facilitating the Operation.

Ustulation. When a Body exposed to the Action of Fire, After a Dissipation

of its volatile parts, retains its Original Texture, and some Degree of Firmness, it is said to undergo Ustula:tion. But if under this process y.^e Body looses its Texture, and falls into a powdery State, the Operation is called Calcination.

The Calcination of many Bodies evi:dently depends upon a Dissipation of their volatile parts, but the Calcination of Metals, and other Bodies w.^h acquire an additional weight cannot be expl.^d by any Hypothesis yet advanced.

In the practise of Calcination we must observe whether our Subject

calcines best in a solid or fluid Form Lead is most readily in the latter. Iron Copper &c in the former State. —

Distillation

This is distinguished acording to the Subject, into simple Distillation (im:=properly called the Chemical Analysis) and Distillation w:th Addition.

I have little to say on ye Subject of simple Distillation, having treated Evaporation so fully. it depends chiefly on the Action of Fire; for ye: small Quantity of Air. contained in ye: distilling Vessel is so diminished by Rarefaction, as to produce no desirable Effect in the Operation. hence the Reason why an

Increase of Heat is necessary towards the End of the Process, when the contained Air is almost entirely driven Out.

Distillation with Addition is a more complex, and a more useful practise than the former. The Addition is made for several purposes. 1st by Elective Attrac:tion for setting loose a volatile part. thus in distilling the Acid from Nitre, we add the Vitriolic, this having a stronger Attraction to the Alkali of the Nitre than its own Acid, seperates the latter, in which State it is easily Obtained Alone. — 2ndly by Elective Attraction for fixing One of two volatile parts. — thus Sal Ammoniac is a Mixt com:posed

of Muriatic Acid, and volatile Alkali, by adding therefore ye: vitriolic Acid, we fix the Alkali, and are thereby ena=bled to seperate ye: Muriatic Acid by Distillation, or again by adding a fixt Alkali we fix the Acid, & seperate the Alkali. — 3d by Elective Attraction for seperating a fixt part, by uniting wh: this, for volatilizing it. thus crude Antimony is composed of Sulphur & a Metalline part. by ye Addition of Muriatic Acid, the Metalline part u=nites wh: it, & becoming volatile rises wh: it in Distillation in ye: Form of Butter of Antimony. at ye: same time

we add Mercury to fix the Sulphur, or we may add the Muriatic Acid & y^e Mercury united in y^e Form of Corrosive Sublimate.

4^th By uniting w^th the Whole a Mist for volatilising it. Thus by adding Copper or Iron to Sal Ammoniac we increase the volatility of both Ingredients. —

5^th By dividing an Aggregate for preventing its Fusion, and thereby favouring its Resolution. Thus if Brick-Dust or ~~powdered~~ dried Clay be mixed w^th powdered Nitre its Fusion is in some Measure prevented, and its Resolution considerably promoted. The ancient Chemists knew the Advantage of this Practise, tho' they were ignorant of y^e Cause.

6.th By dividing an Aggregate for preventing Intumescence, & thereby favouring the Separation of the parts resolved. Air is an Ingredient in all Bodies, and being set at Liberty by Distillation, rises in Bubbles wh: if the Fluid be viscid, collect in such Quanti:=ties as to endanger the Vessels, or rush over into the Receiver. this happens in the Distillation of Amber, and various Other Matters. hence the necessity of adding Sand wch: being in part necessarily car:=ried up ~~by~~ by the Froth contributes by its weight to break the Bubbles before they arise to a considerable Height in the Vessel.

7th For regulating the Degree of Heat E: G:
In the Distillation of Essential Oils we
add Water, wh: can only acquire a deter=
=minate Quantity of Heat, for preventing
Empyreuma. —

Before we proceed to the general Rules for
the practise of Distillation it may not be
improper to explain a few Terms.

When a Matter Obtained by One Dis=
=tillation is subjected to a second, that it
may be more entirely seperated from
Matters that adhered to it in the first,
such second Distillation is named Recti=
=fication, Dephlegmation or Concentration.

Ardent Spirits after a second Distillati=
=on leave a considerable Quantity of Water

wh: they hold at first, and therefore be=
=come more pure, hence they are said
wh: some propriety to have undergone
a Rectification.

Dephlegmation takes its Rise from
Phlegm wh: is the name Chemists have
given to water. this Term is properly
applied when we evaporate water
from any Body wh: contained it. –

When the parts of a Body seperated
diffused in any medium are bro't nea:
=rer together, the Operation is called Con
=centration. neither this Term how:
=ever nor the foregoing are confined
altogether to the Operations of Distillation

In Case 3^{d}: and 4th: When a Matter Ob=
=tained by One Distillation is returned up=
=on y^{e}: same matter from w^{ch}: it was drawn
before, to be again distilled from it for Obtai=
=ning a Stronger Impregnation. such a
second Distillation is called a Cohobation. this
is of two kinds. the first is when the
Matter is returned on the Subject from w^{ch}:
it is drawn. the Second is When y^{e} matter
distilled. not upon the matter from Whence
it was drawn, but upon a fresh porti=
=on of the same kind.

Distillation acording to y^{e}: Form of
the Vessels employed, is distinguished into
1st: That Per Ascensum in w^{ch}: y^{e} Cucurbit

and Alembic are employed.

2ndly That per Obliquum in wch ye Retort is employed.

3dly That per Descensum in wch the vapours are driven into a vessel placed below the Matter from which they are drawn, by means of Fire applied upon an Iron Plate, to the mouth of the containing vessel. this Practise how=ever is now generally deserted.

In the Practise of Distillation we must have Regard to the Form and Matter of the vessels we use.

As to the Matter Glass is certainly

best; as it is capable of containing the most Subtile Bodies, of resisting ye Force of any Menstruum. and has also ye Ad=vantage of Transparency. its ready Fu=sibility however is a Disadvantage.
White Flint Glass is the most fusable of all Others, yet it is to be preferred where ye Degree of Heat will not act upon it. When a greater Heat is required than Flint Glass will bear we may use German Flint Glass; and if we require a greater Heat than this will bear, we may be greatly assisted by giving it a Coat of Windsor Loam. if we are Obliged to employ a greater Heat than any of these (wch is Seldom ye Case) we must use Earthen Retorts.

As to the Form of the Vessels we shall understand them better by seeing the Figures than by verbal Description.

The Vessels should be as thin as is con=
=sistent wth Safety, and of the most uniform Thickness possible. When Bodies whose parts are nearly of an equal Volatility are to be seperated; it is common to employ an Alembic and Cucurbit of such a Height as yt the more volatile parts only may be able to ascend: but I find greater Advantage in this particular ~~Form~~ from a proper Regulation of Heat, than from ye Height of the Vessels. the Cucurbit and Alembic are also inconven

as there are two Junctures to be closed. so yt: the Retort and ye Receiver wh: have but One Juncture, and yt: more easily closed, are now very generally employed. the only Ad:vantage of the former is that from ye: wide=ness of its mouth, we may get matter out for which we shd. be obliged to break a Retort. —

with Regard to the filling of ye vessels. if the Bodies are fluid it must be done by means of a crooked Glass funnel, Care being taken not to let any of the Matter drop upon the neck of ye Retort. In putting in solid Bodies if any portion sticks to the neck, we must wipe it

carefully away. the Vessels according to the Common Rule may be $\frac{2}{3}$ full. This will do for ordinary Matters; but when ye Subject is more disposed to Intumescence, or affords a great Quantity of Elastic Va-pours, the proportion must accordingly be diminished. — When ye Subject is dry and not apt to swell, we may fill the Retort up to the Neck or near it. —

All the Matter sh.d be put in at Once if it can be done, and no Addition made du-ring the Operation. When this is requisite we ought to use tubulated ~~vessels~~ Retorts, that ye Addition may be made without destroying the Lutings. These are also necessary where the Fumes arising from

the Matter to be distilled hinder the Joi:
ning of the Vessels. —
The Vessels sh.d fit each Other so exactly
as to prevent the Escape of the rising fumes.
their Junctures however may be more acu:
:rately closed by the various kinds of Lutings
as Slips made of wet Bladder tied round,
or a Luting made of Meal and Water w.th a
little Whiting, or One of Linseed Cakes and
water, or w.ch is still better, One of made
of Clay, and a Quantity of Sand sufficient
to prevent the Clay from cracking w.th
the Heat. it is proper to let y.e Lutings
be quite dry before we apply the Vessels to
the Fire. —
The proper Application of y.e Fire

comes next to be considered. this shoud be done by very slow and gradual steps Otherwise we most inevitably break our vessel, or cause some part of the Matter to rise w:ch will disappoint us of the Operation.

The Heat applied must be also regula=ted according to y:e Disposition of the Body to expand or intumesce. here we may employ Sand or Brick Dust for the purposes abovementioned.

~~may~~ Many Bodies afford such copi=ous Elastic vapours, that y:e Utmost Caution in Applying Heat will not prevent the bursting of our vessels.

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In such Cases several Expedients have been contrived 1.st the Opening the Lutes. 2.nd the Tube to be inserted into the Receiver w.ch was invented by y.e ingenious Mr Lewis 3.dly the Hole drilled at y.e side of the Receiver. — The first Method is inconvenient and generally attended w.th a Loss of our matter. to the 2.nd we may Object that it is extremely difficult to determine the Size of our Tube; if too large we loose Much of the Matter; if too small it will not conduct our vapour fast eno' to save our vessel. — the third

Method invented by Mr. Godfroy is the most simple and convenient. the Hole must be stopped wth a wooden peg in such a Manner as to be forced out before the vapours are sufficient to burst the vessels. —

Many Substances wch are distilled concrete before they get to the Receiver and by that means stop up the Neck of the Retort. we must avoid this by employing wide-necked Retorts & by keeping the neck hot, that ye Fumes may continue fluid till they arrive at the Receiver. in distilling Butter

of Antimony we are Obliged to apply
burning Coals to the Neck of y^d Retort:
but in most Cases hot water will be
sufficient.

Distillation may be expeded by throwing
Air into the vessels. Dr Hales proposed
this as a convenient method of dis=
=tilling Sea water at a small Expence.
Dr Sthal from the Introduction of Air
thro' an accidental Crack in his vessel
found that the vitriolic Acid became
volatile. We may convey Air into our
distilling vessel by using a tubulated
Retort. —

many methods have been proposed

for separating when it is necessary ye several Matters arising successively in Distillation. the best of these Contrivances is ye Recei=ver wth a Tube going from its Bottom to wch different Vials may be applied for collecting the several parts as they arise.

If, as soon as the Operation is fini=shed the vessels be opened, the cold Air rushing in is sure to break them. Besides many vapours require some time to condense wch by Opening the vessel too soon will be lost: or they are frequently noxious. —

When several Matters are collected in One Receiver, they may be separated

according to their Specific Gravities, by
a Cup constructed wi:th a proper Spout, or
by a Seperatory Funnel. —

In the last place I must Observe y:^{t}
the Fumes escaping in the Course of the
Operation are to be examined, for
these being Often very inflammable or
delitirious may occasion conside=
=rable danger to a heedless Operator.

Sublimation

is conducted by the same principles
as Distillation. its products are diffe=
=rent as they are 1st in powder and are
called Flowers, or 2nd: in solid Concretes
and are then called Sublimates.

To this Acc^t. of Chemical Operations it may be useful to add by way of Appen-dix an Acc^t. of the different Methods of the Application of Fire. —

Appendix.

Of the Application of Fire. —

The Ancient Chemists Observing the Heat arising from Fermentation, from burning Bodies or culinary Heat, from the Rays of the Sun &c supposed that each of these was of a distinct & seperate Nature; but it seems now to be the general Opinion of Philosophers, y^t. these are only different modifications of the same Active Principle of Fire,

The Heat Obtained by collecting the Suns Rays in a burning Glass, is Often very necessary as it is most intense: but since the Heat Obtained from burning Bodies or culinary Fire is most con=venientlly and commonly employed in Chemical Operations we shall treat more fully of its Application. —

In the Application of the Heat com=municated by burning Bodies we consider the

Direction of it, and y^e: Regulation of its Degree.

The Direction is of three kinds	1^st: the naked or Open Fire 2^nd the Reverbera^y: Furnace 3^rd: the transmitted Heat.

The 1^st is employed

— Where a great Degree of Heat is requi:
:red.

Where the Matter to be acted upon
cannot be committed to Vessels.

Where the Matter is not hurt by the
Contents of burning Fewel. —

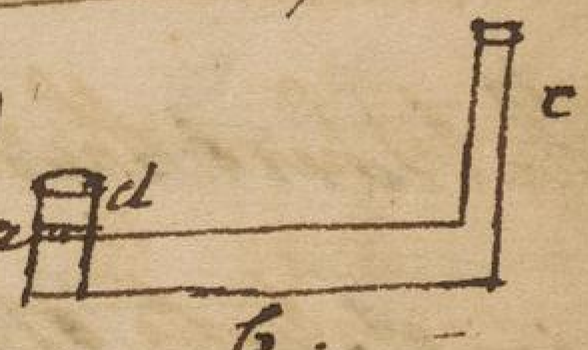
Where the Vessels employed are fit to
Sustain the imediate Action of burning
Fewel. —

The 2^nd or Reverberatory Furnace is
employed. —

Where a great Degree of Heat is requ^d

Where the Heat is to be applied to a
great Quantity of Matter or to a great
Number of Vessels at y^e same time. —

Where the immediate Contact of y:e Fire
would disturb the Operation.
Where it is useful to inflame & consume
the Smoak arising from burning Fuel.
this is affected well by the Focus Acapnus
represented in the Figure.



a is a Grate fixed at the
Junction of the perpendicular
short tube d, and the horizontal tube b
When a Fire is made on the Grate a the
Air in the Tubes becoming rarefied is dri:
:ven by the external Atmosphere violently
thro' the long tube c by w:ch a very entire
Consumption of the Smoak & Sootenness.
this Furnace is employed lastly Where

the Direction of the Fire is best suited for collecting the Matters melted by it.

The 3.^d or transmitted Heat is employed When the Heat is communicated to the containing Vessel thro' Sand, Water or some other Body interposed. This is employed.

Where a Moderate Degree of Heat is requ:^d

Where a very gradual & exactly con:-ducted Heat is necessary. for this pur:-pose Sand is very convenient because both in receiving and loosing Heat it is extremely equable and gradual. –

Where an exactly determined Degree of Heat

is necessary. in this Case we generally employ a Fluid which bears only a deter-mined Degree of Heat. it would be a very useful Improvement upon ye Digestor to enable us to raise the Evaporating Heat of water above the common boiling point at 212°. by regular and certain Degrees.

The Heat of Metal remains equal from the time it begins to melt till the whole is in Fusion. it has therefore been proposed to determine the Degree of Heat by throwing in a ~~piece~~ piece of unmelted Metal, successively as the first is fused. ——

Where the Matter to be operated upon may be hurt by a Communication wth the

burning Fewel, or the Smoak arising therefrom. —

Where the Vessels employed are not fit for sustaining the imediate Action of the burning Fewel. —

Of the Regulation of the Degree of Heat

To be able to regulate the Degree of Heat it is necessary to know ye: Circumstances wch: occasion a greater or lesser Degree of Heat. these are 1st: the Nature of ye Fewel, i e the Quantity of Phlogiston in a gi=ven time. —

It not Only depends upon ye: Quantity of Phlogiston. but also upon the Degree of Density of the Aggregate. thus Straw may have as large a proportion of Phlogiston

as wood, but being of a rarer & lighter Texture, it burns away sooner, and w:ᵗʰ less ~~weight~~ Heat. —

2ˡʸ The Quality of the Fuel being gi:=ven the Increase of Heat depends upon the Quantity inflamed. —

When the Rays of the Sun are collected in a burning Glass, they again diverge from the Focus, and the Intenseness of the Heat decreases in a Ratio with the Distance from the Focus or Centre, because there are fewer Rays in a given Space. now we may consider every inflamed point upon yᵉ Surface of a bur:=ning Body as a Centre, or Focus from

which diverging Rays issue. it is cer=
=tain then that where a greater Quan=
=tity of Matter is inflamed, there will
be a greater Number of inflamed points
and consequently a greater Heat.

3.^{d} The Quality and Quantity of the
Fewel being given, the Increase of
Heat is in proportion to y^{e} more or
less entire Inflamation of it. When a
piece of wood is put into y^{e} Fire
it is n^{t} totally inflamed, for a considera=
=ble part of it flies off in Smoke and
Soot. now if we can by any means
inflame these, the Number of radiating
points will be increased in a given
Quantity

of Matter, and consequently the In-
-tenseness of the Heat. to this Cause
I attribute the great Increase of Heat
by blowing the Flame of a Candle with
a blow-pipe, for a strong Current of
Air investing the Flame confines the
parts, and by keeping them longer in
Contact w.th the Flame occasions a more
total Consumption.
4.th The Degree of Heat is regulated by
the slower or quicker Inflammation of the
Fewel depending on the Velocity of the
Air applied.
The Whole of the Consideration we
are now upon depends upon this. that
the Intenseness of Heat is in proportion

to its Density. the Density encreases according to the quicker Succession of the Application of Heat, now, since Inflamation cannot go on, unless the rarefied Air next the Surface of the Body be succeded by the fresh external Air, the quicker Inflamation will cer:-tainly encrease as the Successions of fresh Air become quicker, which will depend upon the Velocity of the Air applied.

This Velocity of the Air applied is deter:-mined by <u>Bellows</u>, a <u>Water Blast</u> <u>Æolipile</u> or the <u>Structure of Furnaces</u>.

In the Structure of Furnaces we

must attend principally to ye Con=
=struction of the Chimney. from con=
=sidering the Principles upon which
Air is made to rush up a Chimney.
it will appear that the velocity of it
is determined in some measure by
the Height of the Chimney. because
the Column of rarefied Air is encreased.
upon this Supposition, many People
the Iron Founders in particular have
raised thier Chimnies to a most erroneous
Height; but this is certainly unnecessary.
for Mr. Pott finds, that ye Draught of
the Chimney depends more upon the
Ratio between the Diameter & ye Height

than upon y^e: Absolute Height of y^e Chim:
:ney. so that w^th a Diameter of a certain
proportion he Obtained the greatest
possible Heat from a Chimney only 8
Feet high. —

5:^ly The more or less exact Confine:
:ment of the Heat arising from the
burning Feuel. —

Any given Quantity of burning
Feuel exposed to the external air
upon all sides will have much less
Effect upon a useful applied than if
it were enclosed by Brick work, or
Otherwise as in a Furnace &c. it is
not Only of Importance that y^e burning

Fuel be enclosed by some Body, but also that this Body be of such a Texture or Thickness as not readily to transmit Heat, and in general the Thicker the wall the greater will be the Heat.

By the Consideration of ye Regulation and Direction of Heat is ~~evident~~ determined the Structure of Furnaces.

The Parts of a Furnace may be the Ash-hole to receive the Ashes that they not block up the Furnace. the Focus or the place where the Fuel is burnt. the Laboratory or the place where the Matters to be Operated upon are placed. the Chimney wch conveys a swift Currt. of Air thro the Furnace.

The cheif Species of Furnaces are

1st The Forge.
2nd The melting Furnace
3rd The distilling Furnace wth a naked Fire
4th The Assay Furnace
5th The Reverberatory distilling Furnace
6th The Iron Founders Furnace
7th The Potter's Furnace or Kiln.
8th The distilling Sand Furnace.
9th The Athanor
10th The Lamp-Furnace.

End of the Operations of Chemistry.

Of the Chemical History of Bodies

The greatest part of Chemical Know-
-ledge depends upon the Knowledge of
Chemical Facts. these therefore we shall
endeavour to deliver in a Systematic
manner; Our System however cannot
be complete since the Science itself is
Otherwise. we shall consider the Objects
of Chemistry in the Order which we
Observed in the first part of Our Course.
beginning w:th the Saline Bodies as they
have a more general Relation to Other
Bodies than any Class whatsoever.

For the simple Salts & their Definition

see the former part of our work under y^e:
Objects of Chemistry. —

Each of the four Acids may be combined w:th the ~~four alkalies~~ three Alkalies into dif:
=ferent neutrals, and as only one of each can be combined at once it is evident that only 12 neutrals can be formed by them. — the names and various Combinations of w:^{ch} I shall set down in the following Table. the Acids and Alkalies precede each other according to their powers of Attraction. it is extreme
-ly useful to fix in our Memories the Combination of these Salts, & methods by which they may be decomposed. The Vitriolic Acid decomposes y^e neutrals

composed by the Other three. y^e Nitrous those formed by the Muriatic & vegitable. - the Muriatic decomposes those formed by the vegitable.

Before we enter upon the History of the different Salts we shall say some=thing of their Solution, & of the means em=ployed to recover them from their men=strua. Water is universally a menstruum of Salts, and it is doubtful whether any other Bodies can dissolve Salts but in proportion to the ~~Quantity~~ water they contain. a Cubic Inch of water mixed w:th a Cubic Inch of vitriolic Acid will be considerably less than two Cubic

Inches, whereas some Other Salts mixed w:th water give the same or a greater Bulk than they occupied before. This may afford Subjects of Speculation w:ch we shall not enter upon at present.

Salts differ in their Degree of Solubility, but w:t the exact proportion that may be dissolved in a given Quantity of Water we have not been Able to determine, be=cause the Salts themselves are not Steady in their Characters. let it suf=fice that boiling Water dissolves more Salt than When it is at y:e common Heat of the Atmosphere, and that

fixed vegitable Alkali is most soluble,
next regenerated Tartar, next Glaub. Salt
digestive Salt, common Salt, common
Ammoniac, common Nitre, Cubic Nitre,
fossil Alkali, and lastly vitriolated Tartar.
no Accurate Experiments have been made
upon the Other Neutrals. the Quantity of
Salt soluble in water, is in proportion to
the Quantity of Air present in the water,
for if a saturated Solution of Salt & water
be put under the exausted Receiver of ye:
Air Pump, a portion of the Salt will
imediatly precipitate. hence we may
conclude that water when deprived of
some of its Air by Fire does not dissolve

as much as might be expected from the Degree of Heat encreased. Another curious Fact relative to the Solution of Salt is, that when water is saturated w:th One Salt, it will dissolve any other nearly in the same proportion that it would before the first Saturation. a saturated Solution of Nitre added to common Salt dissolves nearly as much of it as if Nitre had not been previously dissolved, and even after the double Saturation the water will be capable of dissolving more Nitre. this may depend upon a fresh portion of water introduced by the common Salt. 12 or 14 Grains

of Corrosive Sublimate may be dissolved in ℥i of water, but if we add a few Grains of Sal Ammoniac the water will dissolve four times as much. The Solution of Salts is also expedited by the Agitation of the vessel, and the Division of the Solvend into smaller parts. —

Various are the methods for recovering Salts from their menstrua, by Evaporation. Crystalization, or Precipitation. — Alkohol added to a Solution of many Salts precipitates them E:G: if to a Solution of Epsom Salt be added a Portion of Alkohol, the former will be precipitated. Fixt Alkali has not in a dry State so much water as it naturally

The Table of neutral Salts

Acids	Alkalies		Neutrals
vitriolic Acid	vegitable	makes	vitriolated Tartar
	Fossile		Glauber Salt
	volatile		Vitriolic Ammon:c
Nitrous Acid	vegitable	makes	Common Nitre
	fossile		Cubic Nitre
	volatile		Nitrous Ammoniac
Muriatic Acid	vegitab:	makes	Digestive Salt
	Fossile		Common Salt
	volatile		Common Ammon:c
vegitab: Acid	vegitable	makes	Regen:d Tartar
	Fossil		Polychres:on of Rochelle
	volatile		vegitab: Ammon:c

requires, therefore it precipitates Neutrals from their Menstruums. — Acids have also the same Effect upon those Salts of which the Acid applied enters into the Composition. as a proof of this we shall find that fixed veg: Alkali added to a Solution of Nitre precipitates it, and unites wth the nitre. and wth Respect to ye second proposition we shall find yt ye Addition of concentrated vitriolic Acid to a Solution of Glauber Salt in Water is imediately succeded by a precipitation of ye Salt.

we may employ Evaporation for Ob=taining a Crystalization wth all ye Salts except the volatile. the Practise is also much less applicable to the Acids than to

the fixt and neutral Salts. the Fixity however is proportionable to their power of Attraction, strongest in the Vitriolic & weakest in the Vegitable. in removing Salts from their Menstrua we may evaporate to Dryness, or Crystalization. the former practise is never to be employed except when the Salt will not crystalize because Salts when deprived of the water necessary for their Concretion, suffer a Decomposition, & often receive an Empyreuma. Even when Evaporation is requisite we ought to lessen ye Appli-cation of Fire by every Other Practise

that will assist us, by exposing it to y^e gentle Heat of the Sun or to the Action of the Air. in these Operations we may use Dr: Hales's Machine for promoting Eva=
=voration w^{th} great Advantage. hence we see the Reason why Common Salt is so much inferior to Bay Salt both in the Beauty of its Crystals and Anti=
=sceptic Quality, the former being Ob=
=tained by y^e boiling heat, and the latter by the gentle Heat of the Sun. The general Rule for knowing when y^e Evaporation has proceeded far eno, is to evaporate 'till a pellicle Appears upon y^e Surface

of the Liquor, and then set it to cool, and crystalize. this Rule however is not general. for in some Cases as in the Crystalization of Nitre no pellicle appears at all. therefore we must judge by the Quantity of the Menstruum evaporated, or by taking a few Drops to cool, of this sort is Nitre. If we would have large fair Crystals we must cool the Liquor slowly, if it is cooled suddenly, and in large Vessels the Salt calcines. the Manufacturers of Gun-powder avail themselves of this Practise for reducing the Nitre to powder at the time they Obtain it by Evaporation. When more Salts than One are suspended

15/ in a Menstruum we must seperate them by Evaporation, taking advantage of a great Disparity in the Shape of or Size of their Crystals or of their Solubility in Water. E.g. a Quantity of water that in $\frac{e}{y}$: com=
=mon Temperature of the Air dissolves $\frac{1}{3}$ of Common Salt will dissolve $\frac{1}{5}$ of Nitre; but if the Water be raised to a boiling heat, the Solubility of the Nitre is almost unli=
=mitted, while that of Common Salt is encreased in a proportion considerably less; hence it is evident if we evaporate the Liquor properly a large Quantity of Common Salt will be crystalized Whereas the Nitre is entirely suspended. So y^2: by repea=
=ted Evaporation w: $\frac{e}{y}$: Addition of fresh water

we may seperate the Salts very accurately.
this Practise occurs wherever Nitre is made,
& likewise when fossil Alkali obtained
from Sea weed, is to be seperated from ye
Common Salt which always adheres to
it. The Solubility of fossil Alkali is to
that of water :: 8:3. We must here ob-
-serve that previous to the Evaporation
of mineral waters we ought to purify
them by Filtration, or Clarification wth
Animal Fluids, wch entangle ye particles
floating in a liquid, and retain them
in a Coagulum.

That the Air is extremely necessary

for Crystalization appears from the following Experiment. If a supersaturated Solution of Nitre be closely confined while hot in a proper vessel, the Liquor will remain for any time in the open Air perfectly fluid, but if the vessel be opened, and ye external Air admitted, the superfluous Quantity of Salt wh the hot water suspended will instantly subside. —

It has been laid down as a certain Rule that we may distinguish Salts by the various Forms wh each assumes; yet this Rule has given Rise to inumerable Errors, since the Shape into wh any Salt concretes is never constantly uniform. for Instance common Salt usually

forms Crystals of a Cubic form, but two of these very frequently join, and form a Parralellopepid. some Salts form hex=agonal prisms, but these also form Cones or Frusta of Cones. they often concrete in the same form: as Glauber Salt and Nitre which have been fre=quently mistaken for each Other. all q:n we can say upon this Subject is that Vitriol:d Tartar generally concretes into hexagonal Pyramids; Common Nitre & Glauber Salt into hexagonal prisms. q:e Crystals of the ~~latter~~ former are usually larger. — Cubic Nitre into Rhomboidal, & com=mon and digestive Salt into Cubical

Crystals.

Salts not only concrete in particular forms, but also in a determinate position, generally vertical to the plain on w:ch they fix. common Salt concretes usually on the Surface of the Liquor: Nitre in a perpen=dicular, and Glauber Salt in a horizontal Position to the Bottom of the vessel. I for=merly imagined that these Positions were very permanent, but I have found by Experiment that the Concretions begins where the vessel is coolest, so that by apply=ing Cold to One part of the vessel, sooner than another we may determine at pleasure where the Salts shall begin to crystalize. — I took this Hint from

Mr Reameaur on Antimony. — This as we generally have it consists of a Bundle of Fibres whose Direction is from the Apex of the Cone towards the Basis. the Reason of this Direction of the Fibres seems to arise from the Shape of ye: Antimonial Horn, which is a Cone inverted, & conse=quently the Bottom would cool soonest; for Mr Reameur found that by keeping the Bottom of the Horn in warm Sand, and applying a cool Body to the Side, ye: Direction of the Fibres became horizon=tal.

Besides the Air which we have observed is extremely necessary for promoting the

Crystalization of Salts, they all retain a proportion of water, the Dissipation of w:ch is always attended w:th the Demolition of their Crystaline Structures w:ch may be again recovered by a proper Addition of water. y:e Crystals of Glauber salt retain $\frac{3}{4}$ of water, nitre receives only $\frac{1}{2}$ of water into its Crystals. vitriolated Tartar receives still less. hence the Distinction of Crystaline & diliquescent Salts. in those of y:e Above mentioned Salts w:ch are disposed to crystalize at the sides of the vessels, if Heat be applied thereto, the Crystals push each other till they rise over the Brim. this was once thot a very surprising Phanomenon, & termed the vegitation of Salts. there is a

curious Fact relating to Crystaline &c dilaquescent Salts, that the former gene-
-rate Cold, and the latter Heat when mixed w:th water.

When neutral Salts are crystalized w:th water, the Mass is expanded. Selenites (which have been very Absurdly kept from the Class of Salines and transferred to y:^{e} of Earthy Bodies) suffer a very remarkable Expansion when calcined, and mixed w:th water. hence its usefulness in receiving the most minute Impression of a mould, and hence y:^{e} Bursting of a vial if accurately, and suddenly closed. After being filled w:th a mixture of Sele-
-nites,

and water.

Having premised these general Observa=
=tions concerning Salts we shall proceed
to consider each particular Object of
Chemistry in the following Order. 1.st we
shall examin whether the Substance is
natural, or Artificial, simple or Com=
=pound? – If natural we shall examine
in w.ch State it is presented by nature? if
Artificial by w.ch means it may be Ob=
=tained? if Compound w.t Bodies com=
=pose it? – 2.ndly we shall consider y.e Sub=
=stance both in itself, and as relative to
Other Bodies, w.ch may be strictly called its
Chemical History; and this the whole I shall

adopt the Order before established begin-
-ning with the saline. -

Of the Vitriolic Acid

Vitriolic Acid is a native Substance. nor does it appear that it can be produced by Art. it is seldom presented by Nature in a pure State, being generally com=
=bined w:th Other Bodies, as w:th fossil Alkali into Glauber Salt — w:th fossile Oils. but never w:th Animal or Vegitable Bodies. It has been a Matter of Controversy whether it appears even in fossile Oils. it unites w:th Phlogiston into Sulphur, & as Sulphur enters into the Composition of most Metals. the Vitriolic Acid frequent=
=ly unites w:th them especially w:th Iron forming green — w:th Copper forming blue. and w:th Zinc forming ~~green~~ White vitriol. it is found

w:^th Earths. forming w:^th the Calcarious

Selenetes, w:^th Magnesia a Salt much

resembling Glaubers — and w:^th part of com:

=mon Clay Alum. it is found in Mineral

Waters as accompanying Other Bodies

diffused therein, or if it be found pure it

is Only in Consequence of the Water's wash:

=ing it from Some Body w:^ch has suffered a

Decomposition. this Often happens to Pyri:

=tes from the Action of the Air. we sometimes

see the Effects of Vitriolic Acid in y^e Air.

but Whether it is there present in its

seperate State, or attending Other Bodies

exhaled into that fluid we have not

determined by any Experiments. the fol:

=lowing

Arguments are offerred to prove that this Acid exists in the Air independant of other Bodies 1.st If you expose fixt vegitable Alkali to the Air, and then crystalise it, the Crystals will have the Appearance of vitriolated Tartar. 2.nd That metals are cor=roded, and the Colour of Silks changed by being exposed to the Air. To the 1.st of these Argum.ts we may object that no satisfactory proof to show that the Salt produced ~~was~~ was vitriolated Tartar. To the 2.nd we may object that the very same Effects arise not only from the Action of Acids, but of y.e Alkaline and neutral Salts, many of which we might more reasonably expect to find in the Air than the vitriolic. This Acid

is so universally diffused throughout ye Bowels of the Earth, yt some have suppo-sed that it floated wth Vapours in all subterraneous Caverns, which Hypothesis is true perhaps wth Respect to all especially such as are deleterious. When in ye floating State just mentioned to which it is reduced by an Accidental Decomposition, it becomes volatile. it appears likewise yt it is present in the Electrical Æther, from the Effects which ye latter has in changing ye Colour of Roses and violets – from ye Smell which it produces After Explosion, and from the Taste wch People have sometimes

perceived After an Electrical Shock. if we were more certain of the presence of ⊕r in the Electrical fluid. we might be induced to recall the Objections made to y^e Univer=
=sal Diffusion of it thro' the Atmosphere. the Phosphorus of some Animal Substances contains an Acid very similar to it, but not proved actually to be the vitriolic.
After the Incineration of vegitables a Salt is found very much resembling vitriolated Tartar. the Experiments however upon this Subject are few, deficient and in=
=accurate. it must still be a Subject of future Inquiry whether the Salt of the vegitables is really vitriolated Tartar,?

If so, whether it originally existed in the entire vegitable? – or whether it was introduced in Consequence of Incineration? –

The vitriolic Acid is chiefly procured by us for the purposes of Art, from vitriol, Sulphur and Alum. the practise upon ye latter is now entirely neglected. vitriol & Sulphur are most generally employed; of these Sulphur is to be preferred since it is supposed to contain $\frac{15}{16}$ of vitriolic Acid. You will find Directions for conducting these Processes in Macquer and Boerhaave. I must here Observe ye I shall seldom enter into a Detail of the Processes, as they are de=
=scribed wth sufficient Accuracy by Macquer.

I shall always therefore suppose that you have Recourse to his Book, & only make a few Observations as I find Occasion.

With Respect to the Practise upon Vitri=ol I shall Observe that y^d Calcination before Distillation serves not only to dissi=pate the large proportion of water con=tained in the Vitriol $w:^{ch}$ might Otherwise Obstruct the Process, but also to prevent the Fusion of the Vitriol during Distilla=tion, $w:^{ch}$ would infallibly break our vessels. Earthen vessels are most proper for this purpose. the Heat must be very gra=dually encreased till watery Vapours arise,

then we must keep it equal till they rise less copiously. the Heat must then be encreased till the Acid begins to rise, the Heat must again be preserved equal till white Clouds appear; After those are removed we may encrease the Heat to any possible Degree. the Stop=ping the Distillation at a proper time can Only be understood by those who have been very conversant in the Ap=pearances which occur in the process. —

Tho' Sulphur contains such a re=markable proportion of Acid, yet not more than 2 or 3 Ounces could be Ob=tained from a pound of Sulphur by any

of the former practises. the rude unprofita:
-ble practise invented by Geber has long
been deserted. the next method was "per
Campanam" but the Air in the Bell soon
became too hot for condensing ye Fumes,
wch arose from the Sulphur below. Homberg
improved upon this method by inserting a
long tube for admitting the Air. this tube
suffered a great Quantity of the Fumes
to escape. in short all Attempts were
ineffectual till a Chemist of Holland some
say one Cornelius Drebbel practised it
wth excessive large vessels, & wth the Addition
of Nitre, wch enabled the Sulphur to inflame
without any imediate Communication wth

the Air. the Quantity of Nitre is said to have been About 6 pounds to 100 of Sulph^r: These proportions are so unequal, that their union w:^ch would certainly take place in Distillation was attended w:^th no Incon=venience. M^r. Ward introduced a method into England, and Obtained a Patent for the practise, by w:^ch he procured a very great Proportion of Acid from the Sulphur. a Gentleman having discovered y^e ~~…~~ Process settled a Factory at Preston=Pans in Scotland. it is however a Secret in the hands of very few People. various con=jectures have been formed concerning the Method of this Practise. from the

uncommon Size of the vessels w.^ch they procure, some have imagined that it is only some trifling Improvement upon the Method just mentioned of Cornelius Drebbel. Mr. Dossy in his „ Elaboratory laid open,, pretends to have discovered y^e true Practice, but whether w.^th certainty or not we cannot determine. —

The Practice w.^ch we have directed for Green vitriol must be Observed in y^e Distillation of Other vitriols or Alum.

This Acid as we receive it from y^e Manu=facturers always contains a large pro=portion of water, and it is more or less of a dark Colour occasioned by y^e: presence of foreign and chiefly inflamable Matters, all

of which change the Colour of this Acid. to Obtain it then free from adhering matters we must subject it to frequent Distillations. – the transparency of the Acid is a Mark of sufficient purity for common purpo=ses. but the most certain Rule is the Examination of its Specific Gravity at every Distillation, and when its Gravity is to ye of Water as 18 to 10 it is sufficiently con=centrated for any purposes of Arts or Chemistry. we also rectify the Acid of Vitriol by open Evaporation, as the Water and Phlogiston are more volatile than the Acid; but this is attended wth a large Dissipation of ye Acid.

Having now considered the different methods of Obtaining the Vitriolic Acid,

let us next examin its Properties alone &
as relative to Other Classes of Bodies. the
Vitriolic Acid is generally fluid, tho' it
Sometimes forms icy Concretions. Mr.
Hellot says it is reduced to a solid form
by distilling it wth: intense Heat & close
vessels. I suspect that its Disposition to
Solidity depends upon the presence of in=
=flammable Matter. this Subject however
is not sufficiently illustrated by Experiments, so
yt: we are not certain by wt: it is rendered solid,
nor can this Effect be produced by Art
tho' it Often happens accidentally. its
Specific Gravity is greater than yt: of any
Other Fluid except Quick-silver. When

pure it is perfectly colourless & emits
no sensible Odour. When mixed wi: a very
small portion of Phlogiston it assumes a
brown Colour, and if the Quantity is
encreased it will proceed to perfect Black=
=ness.

It unites wi:the every Species of Acid effer=
=vescing and generating Heat. I dare
not however affirm whether it unites
wi:the the pure Acid, or the Water they gene=
=rally contain. They certainly unite & af=
=ter into a Substance possessing ye Proper=
=ties of neither. Thus Nitre & Muriatic
Acid do not act upon Gold in a seperate
State, but when combined they form an

Aqua Regia that readily dissolves that Metal. —

It unites w:th all Alkalies effervescing and generating Heat. the former of these Appearances is not universal since there is a State of the Alkali in w:ch the Addition of Vitriolic Acid is attended w:th no Effervescence, but more of this when we treat of Alkalies. — two Phænomena however constantly result from their Union viz: ye Generation of Heat, and the Production of a neutral Salt, possessing the Properties of neither ye Acid nor the Alkali. these Salts differ according to the Species of Acid employ=ed. they may be seen in the Table of Neu=tral Salts. it also dissolves & Attracts

Alkalis more strongly than any other Acid, and it is in consequence of this property that we can separate the Acids from any other neutral Salts as we Observed before. —

The Vitriolic Acid unites with Oils in gene=ral, producing Effervescence, Heat, and more or less of a dark Colour. This mixture subjected to Distillation produces a portion of genuine Sulphur. it is doubted whether Vitriolic Acid admits of any Combination. One would imagin that it does not, since Sulphur appears always satura=ted; yet some of its Effects deserve Attention. Sulphur moistned with Oil runs in the Air per Deliquium, and becomes less Inflam=ble

—It suffers a Change also by Digestion.

Vitriolic Acid unites wth: all Metallic Bo=
=dies except Gold. Some have thot that
Gold might be combined wth: it. it suspends
many of them in a fluid Form, Others it
only corrodes. it will not dissolve Iron
when highly concentrated, but requires Di=
=lution. this is the Case also wth: Zinc, but
Copper requires a very concentrated Acid
for its Solution. most of the Other Metals
require not only a very concentrated
Acid for their Solution, but also ye Assis=
=tance of boiling. such are Silver Lead
Tin, Antimony, Bismuth, Quicksilver
& Arsenic. its Effects upon Platina Nikel

& Cobalt have not been ascertained as these Metals have been but lately disco=
=vered.

Vitriolic Acid unites w:th Absorbent Earths of all kinds w:th Effervescence & Heat. w:th 2 4 Species called Calcarious. it forms Selenetes, w:th magnesia Alba a purging bitter Salt, — w:th Animal Earth a Salt to w:ch no name has been affixed, and w:th Earth of Alum a Salt of the same name. Mr: Margraff informs us that Earth of Alum, and Vitriolic Acid will not crystalise except a overproportion of the Earth be added. This is a curious Fact, the Rationalia of which we do not understand. —

Vitriolic Acid unites w:th water. in a fluid State it generates Heat, but w:th Ice it ge=
=nerates Cold. in a concentrated State it attracts moisture from the Air.

We have not yet determined its Effects upon the Air. it seems however to show a peculiar Relation to the Mephitic Species.

It dissolves ~~a part~~ all, or a part of every Animal, & Vegitable Substance, generating Heat, and producing more or less of a black Colour, in proportion to the Phlogiston they contain. it checks also the vinous Acetous and putrefactive Fer=
=mentations. —

Of the volatile vitriolic Acid.

We have considered the vitriolic Acid

heretofore in its fixt State, ponderous in=
=oderous, and emitting no Fumes. let
us now consider it in its volatile State,
less ponderous, Oderous, and copiously
emitting ~~volatile~~ pungent Fumes. Dr. Sthal
accidently discovered the method of volati=
=lizing this Acid. While he was distilling it
a sudden Stream of Air broke ye Vessel, & ^
on Examination he found that ye Liquor
was volatilized. it is obtained also volatile
from Sulphur, White vitriol, & from all
Combinations of the Acid wth Oils or Alcho=
=hol. the volatile Acid is disposed like ye
former to congeal in wch State it loses
its Odour, but recovers it wth Fluidity.

It discharges the Colour of Violets Altogether, without turning them red. their Colour may be recovered by a fixt Alkali. Neutrals formed by it may be decomposed by the fixt Vitriolic Nitrous, or Muriatic Acids. it unites with all the Other Classes of Bodies nearly in ye same manner as when fixt. its chief Peculiarities are as follows. it is more powerful Menstruum to Alkalies than ye fixt since. the fumes of 16 Ounces of Sulphur will dissolve a greater Quantity of Acid, than 16 Ounces of the most concentrated fixt Acid. its Effects upon Inflamables are inconsiderable. it unites difficultly wth Alkohol, nor will their union produce

Æther. - its Effects upon Metallic, Earthy watery and Aerial Bodies are nearly ye same as those of the first, only less powerful. the same Observation is true wth Respect to ye Animal and vegitable. - it may be rende=red fixt by a gentle Calcination wth fixt Alkali; - by Addition of water - or by Com=munication with the Air for a long time.

- For an Acc: of the Synonima of this kind & of all the other Salts, see Black's Chemistry.

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